AN ESTIMATION OF POTENTIAL SALMONID HABITAT CAPACITY IN THE UPPER MAINSTEM EEL RIVER, CALIFORNIA

By

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ABSTRACT

AN ESTIMATION OF POTENTIAL SALMONID HABITAT CAPACITY IN THE UPPER MAINSTEM EEL RIVER, CALIFORNIA

Emily Jeanne Cooper

In Northern California's Eel River watershed, the two dams that make up the Potter Valley Project (PVP) restrict the distribution and production of anadromous salmonids, and current populations of Chinook Salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*O. mykiss*) in the upper mainstem Eel River are in need of recovery. In anticipation of the upcoming FERC relicensing of the PVP, this project provides an estimation of the extent of potential salmonid habitat and its capacity for steelhead trout and Chinook Salmon in the upper mainstem Eel River watershed above the impassable Scott Dam. Using three fish passage scenarios, potential Chinook Salmon habitat was estimated between 89-127 km (55-79 mi) for spawning and rearing; potential steelhead trout habitat was estimated between 318-463 km (198-288 mi) for spawning and between 179-291 km (111-181 mi) for rearing. Rearing habitat capacity was modeled with the Unit Characteristic Method, which used surrogate fish density values specific to habitat units (i.e. pools, riffles, runs) that were adjusted by measured habitat conditions. Redd capacity was modeled and resulted in up to ten times the number of spawners compared to those recruited from parr capacity estimates using life stage-specific survival rates. Capacity for rearing juveniles was suggested to be most limiting to production for both

Chinook Salmon and steelhead trout, although more accurate survival rates for all life stages for each species is needed. Ample potential spawning habitat, however, suggests an opportunity for spawners to saturate the stream seedbank for egg recruits, and as rearing capacity is reached in the streams above Scott Dam, subsequent juveniles may then emigrate to non-natal habitat downstream of Scott Dam.

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INTRODUCTION

Salmonid populations native to western North America are subject to a combination of anthropogenic manipulations including agriculture, flood control, logging, mining, development, fish hatcheries, climate change impacts, and dams and diversions (Rosenfeld et al., 2000; Burnett et al., 2007). As a result, 81% of anadromous taxa are threatened with extinction in California (Katz et al., 2013). Dams regulate most major waterways in California, and salmonid population decline is linked to the changes caused by stream regulation (Katz et al., 2013; Quiñones et al., 2014). Large flood control and hydroelectric dams have contributed to freshwater habitat degradation and species decline through watershed fragmentation, disruption of natural flow regimes, interference with nutrient distribution, inundation of stream habitat directly upstream of a dam, and blockage from historical salmonid spawning and rearing habitat (Sheer & Steel, 2006; Quiñones et al., 2014). Not only have these effects reduced salmonid population production, but they have also impacted life history diversity in local fish populations, which historically thrived under California's diverse Mediterranean climate of wet winters and hot, dry summers (Katz et al., 2013).

Anadromous salmonid populations in the Eel River watershed in Northern California have been impacted by two dams that are part of a water storage, diversion, and hydropower complex known as the Potter Valley Project (PVP) (USFS & BLM, 1995). With historical production estimates at nearly 1 million fish annually, the Eel River contained some of the West Coast's most abundant runs of anadromous salmon and trout, including Chinook Salmon (*Oncorhynchus tshawytscha*), Coho Salmon (*O. kisutch*), winter and summer steelhead trout (*O. mykiss*), and coastal cutthroat trout (*O. clarki*) (Yoshiyama & Moyle, 2010). Coho Salmon, Chinook Salmon, and steelhead trout are currently between 1-3% of their historic populations and are federally listed as threatened in the Eel River watershed (Yoshiyama & Moyle, 2010; NMFS, 2012). Salmonid populations in the upper mainstem Eel River watershed consist of fall-run Chinook Salmon and winter-run steelhead trout. There have been few observations of Coho Salmon or cutthroat trout in the upper mainstem Eel River over the past few decades, likely because this reach of the river extends beyond present Coho Salmon and cutthroat trout distribution (Xanthippe, 2004; PVID, 2016).

As salmonid populations throughout Pacific Coast watersheds have been increasingly listed under the Federal Endangered Species Act, fisheries management has responded with recovery strategies involving passage and habitat restoration that reintroduces anadromous salmon and trout into their historic habitats (Hanrahan et al., 2004; Pess et al., 2008, NMFS, 2015). Planning restoration and reintroduction efforts often involves efforts to predict the increase in salmon production associated with enhanced access to habitat. Several past efforts have estimated the potential amount of habitat and salmonid production upstream of Scott Dam. These estimates, however, were calculated with large-scale habitat measurements and relatively simple methodologies, resulting in discrepancies as to how much habitat and production potential there is for anadromous salmonids under current conditions.

Literature Review

Previous Assessments in the Upper Eel River Watershed

Previous salmonid habitat assessments conducted in the watershed area upstream of Scott Dam were done to estimate potential salmonid abundance, but results are inconsistent among these efforts. Abundance estimations vary in part due to approaches ranging in their consideration of abundance as minimum, average, or maximum salmonid production. A study conducted by Venture Tech Network (VTN) in 1982 quantified a total of 35.7 miles of major channel habitat and an additional 22.7 miles (totaling 58.4 miles, or ~94 km) of minor channel habitat being blocked above Scott Dam (VTN, 1982). The assessment methods for the VTN (1982) study consisted of reconnaissance level air surveys along with ground-level surveys in select locations, and results included the identification of barriers to anadromy in the waterways upstream of Lake Pillsbury along both the mainstem Eel River as well as the Rice Fork tributary. In 1995, the US Forest Service (USFS) and Bureau of Land Management (BLM) released a “Watershed Analysis Report for the Upper Main Eel River Watershed,” in which they estimated about 100 miles (160 km) of anadromous fish habitat being blocked by Scott Dam, but methods for this estimate were not elaborated upon (USFS and BLM, 1995). In 1999, the Center for Ecosystem Management and Restoration (CEMAR) provided a synthesis of information on historical distribution and current status of both anadromous and resident *O. mykiss* in the upper mainstem Eel River both upstream and downstream of the Potter Valley Project (Becker and Reining, 1999). The CEMAR study reports distribution and use of almost all streams by resident rainbow trout and anadromous steelhead trout both historically and currently above Lake Pillsbury, beyond those barriers to migration classified by the VTN (1982) report.

VTN estimated potential abundance from historical and current scenarios for habitat conditions and with density values derived from spawner surveys in other streams of the Eel River watershed, resulting in a historical estimate of 3,356 steelhead trout spawners and 2,499 Chinook Salmon spawners and a current estimate of 1,499 steelhead trout spawners and 1,250 Chinook Salmon spawners (VTN, 1982). Some unpublished data from California Department of Fish and Game (1979) estimates historical abundance in the watershed area above Scott Dam to be 2,500 steelhead trout and 2,300 Chinook Salmon. While historical estimates made by VTN and CDFG are relatively close for Chinook Salmon (difference of ~200 spawners), historical estimates for steelhead trout have a larger difference (~850 spawners). Estimates for current abundance are close to half of those for historical abundance. These disparities and their applications for management are unclear, therefore creating the necessity for a more rigorous effort to estimate potential salmonid abundance upstream of Scott Dam.

An additional approach for estimating potential habitat and abundance comes from the Intrinsic Potential (IP) Model developed by NMFS (2016). The IP Model maps potential stream habitat in a Geographic Information System (GIS) and estimates potential abundance from other data containing spawners per linear unit. IP Modeling utilizes large-scale habitat suitability indices including slope, valley constraint, and annual discharge to determine the potential range of accessible habitat for salmonids (NMFS, 2005; Burnett et al., 2007). The IP Model uses a 10m resolution Digital Elevation Model (DEM) to determine channel gradient for an entire stream network in GIS. Habitat requirements for a salmonid species of interest are evaluated using IP parameters, and areas upstream of identified barriers for migration are omitted. Each segment of stream within the model's data frame is assigned a score from 0 – 1, with 1 being the highest qualification for intrinsic potential of salmonid habitat. Then, the model calculates a total IP-km value, which includes the sum of each stream segment length multiplied by its IP score. The IP-km value is considered the amount of stream length that provides suitable salmonid habitat, which can differ from the total stream length mapped. The IP model is designed for estimating potential adult fish density per 1 km stream segment based on its habitat suitability parameters and rating scale related to abundance (NMFS, 2005). In the upper mainstem Eel River watershed, NMFS estimated 20 spawners per 306 IP-km for steelhead trout and 20 spawners per 103 IP-km for Chinook Salmon (Spence et al., 2008 & 2012). The IP Model resulted in estimates of 6,120 steelhead trout spawners and 2,060 Chinook Salmon spawners.

Drawbacks of the IP model include overestimation of suitable habitat, limited accuracy of habitat characteristics at the reach level, limited application of habitat suitability parameters, and assuming a standard number of spawners per IP-km across a large scale (Sheer et. al, 2008). Over-prediction of suitable habitat could be caused by suitability curves attributed to the IP score whose parameter thresholds may not be sensitive enough to reflect actual habitat use by fish (Sheer et al., 2008). Furthermore, because the IP Model is built from a 10m resolution DEM, the model could be too coarse to capture important small-scale physical habitat features within the 100m^2 pixels that make up the elevation model. As a result, the coarse resolution could affect the utility of the IP score. Many studies have measured relationships between small-scale physical habitat characteristics and juvenile salmonid abundance and found positive associations with large woody debris (LWD), undercut banks, and pool habitat (Rosenfeld et al., 2000; Polivka et al., 2014; Gallagher et al., 2014). Such habitat parameters that affect fish abundance may not be captured by the coarse spatial resolution of the IP model. As understanding ecosystems on a larger, meso-habitat scale is important for considering large populations, meaningful small-scale habitat requirements must not be overlooked, as they contribute to what defines the suitability parameters that shape a habitat-abundance model. In addition to large-scale habitat features, quantifying small-scale habitat features (i.e. habitat unit composition, substrate composition and embeddedness, and instream shelter features) as they relate to salmonid abundance at different life history stages provide parameters necessary for assessing habitat-population dynamics and estimating potential production in prioritized watersheds (Anlauf-Dunn et al., 2014).

Biology of Salmonids as a Foundation for Modeling Population Capacity

Understanding the myriad of salmonid life history strategies both within and among species is essential for assessing habitat conditions and modeling habitat-abundance relationships as they pertain to population recovery. Instream habitat conditions change as seasonal flows vary, so salmonid species occupy streams in different ways depending on discharge, temperature, dissolved oxygen levels, food abundance, time of year, and life stage (Dill et al., 1981; Keleher and Rahel, 1994; Spence et al., 1996; McCullough, 1999; Nicola et al., 2015). Thus, when assessing spawning and rearing habitat, temporal instream conditions must be considered for each salmonid species and life stage of interest. Spawning occurs during fall and early winter high flows for fall-run Chinook Salmon, and winter steelhead trout spawn in late winter to spring (Quinn et al., 2002). Steelhead trout generally spawn in stream gradients from 2-7%, but possibly up to 12%, so their distribution extends farther upstream than that of Chinook Salmon, who spawn in gradients from 0-2% but possibly up to 5% (Merz, 2001; NMFS, 2005; Cooney and Holzer, 2006). Emergence, rearing, and emigration of salmonids are highly variable not only among species but also within a single species due to life history plasticity and local adaptations in response to environmental variation (Waples et al., 2001; Beckman et al., 2003; Quinn, 2005).

The juvenile stages of life for Chinook Salmon and steelhead trout from egg to emigrant respond to spatio-temporal changes in habitat conditions. Fall-run Chinook Salmon eggs are spawned in the mainstem and larger drainages of a watershed and emerge in the spring; juveniles usually begin migrating out to sea within a few weeks or months of emergence (Healey, 1991; Moyle, 2002; CDFW, 2016). In contrast, steelhead trout juveniles that emerge in the spring typically occupy pool habitats throughout summer and winter as young-of-the-year and can remain in freshwater for one to three or more years before beginning their oceanic journey (Quinn, 2005). Limiting factors change throughout the year for salmonid juveniles rearing in streams. During winter and spring, large woody debris (LWD), boulders, and interstitial spaces in cobble and gravel substrate act as instream shelter providing velocity variability and high flow refugia necessary for juvenile survival (Cunjak, 1996; Hillman et al., 1987; Solazzi et al., 2000). During summer and fall, juvenile salmonids become susceptible to rising temperatures, loss of habitat connectivity, and an increasing demand for territory size while space becomes decreasingly available (Keleher and Rahel, 1996; Isaak et al, 2007; Cramer and Ackerman, 2009a; Ayllon et al., 2012). Emigration timing is dependent upon growth rate and cues from temperature and discharge conditions (Beckman et al., 1998; Quinn, 2005; Berggren and Filardo, 2011).

Salmonid redd-building requires suitable-sized streambed substrate, and that substrate is typically deposited from high flows at the transition zone between a pool and the downstream riffle (CDFW, 2004). Although gravel size is the most important variable for redd selection, pool tailout areas are also important in that they are consistently reported as having highest redd densities because of the presence of suitable spawning gravel and appropriate depth and velocity requirements (Baxter and Hauer, 2000; Mull and Willzbach, 2007; Cramer et al., 2012). Increasing embeddedness from fine sediment within the substrate degrades redd-building conditions for spawners and decreases survival rates for salmonid eggs living in the benthos by blocking hyporheic exchange of oxygen, flow, and light (Keeley, 1996; Suttle et al. 2004; Allan and Castillo, 2007; Wilzbach and Cummins, 2008). Thus, substrate composition and embeddedness are key characteristics for quantifying potential spawner habitat.

Typically occurring between 10s to 100s of meters in length, habitat units (e.g. pool, riffle, and flatwater) are functions of geomorphic and hydraulic conditions that change spatio-temporally with varying discharge, and fish occupy different habitat unit types at different life stages (Rosenfeld et al., 2011). Therefore, salmonid habitat can be measured by identifying habitat units in response to how they are selected by salmonids. The distribution and proportion of habitat units within a stream reach at low flows can be used to approximate the quantity of juvenile summertime-rearing habitat (NMFS, 2015). Quantifying winter and spring rearing habitat capacity must reflect how habitat type composition changes with seasonal variation in discharge to estimate seasonal habitat use by salmonids (Rosenfeld et al., 2011). Two studies conducted by Rosenfeld et al. (2007, 2011) compared rates of change in hydraulic conditions (e.g. velocity, wetted width, and depth) at low flows compared to high flows. These hydraulic conditions distinguished individual habitat units at lower flows; however, at higher flows, increases in velocity, wetted width, and depth caused habitat units to converge and become less distinguished. These rates of change in hydraulic conditions were then quantified specific to habitat unit type. By applying the rates of hydraulic change specific to habitat unit types, different flow conditions can be modeled from stream measurements that lack a temporal resolution representative of seasonal flow variation (Rosenfeld, 2007).

Understanding the biological nature of Chinook Salmon and steelhead trout and how their habitat use changes among life stages is essential to modeling their potential habitat use in the upper mainstem Eel River upstream of Scott Dam. Relating habitat use to habitat availability from other studies identifies potential limitations to population production both spatially and temporally. Habitat conditions and their relationship to habitat use and fish density may then be modeled to estimate potential capacity, or maximum potential production, for anadromous salmonids in the study area.

Research Objectives

Populations of native salmonids in the Eel River have been affected by degraded habitat conditions; as a result, these populations require recovery management. Since its construction in 1922, Scott Dam has completely blocked passage to habitat historically used by migrating salmonids. Now that the Potter Valley Project is approaching a 50-year Federal Energy Regulatory Commission (FERC) license renewal in 2022, there is a need for current, sound science that quantifies potential salmonid habitat extent and capacity upstream of Scott Dam. The National Marine Fisheries Service (NMFS) multispecies salmonid recovery plan assigned a high priority to population recovery in the upper Eel River, calling for measures in addition to those that previously existed in response to the relicensing decision for the Potter Valley Project (NMFS, 2016). With regard to informing the PVP relicensing decision and recovery management for anadromous salmonid populations in the upper mainstem Eel River, the objectives of this research were to assess and quantify the habitat upstream of Scott Dam and estimate the potential population capacity of juvenile parr and spawners for steelhead trout and Chinook Salmon if access to the area were restored.

METHODS

Study Area

The Eel River watershed is the third largest watershed located entirely within California, draining about 9,542 km^2 (FOER, 2016). This coastal watershed is comprised of five major tributaries and the mainstem, totaling 1,288 river km spanning from the headwaters at 1,640 m elevation in the coast mountain ranges of western Mendocino County to the Pacific Ocean near Fortuna, California. The upper mainstem Eel River is the area upstream of the confluence with the Middle Fork Eel River, south east of Dos Rios, California within the North Mountain Interior diversity stratum (NMFS, 2015). This stratum coined by NMFS includes watersheds draining relatively high elevation mountains in some areas of the Eel River watershed as well as in the Klamath mountains ecoregion (NMFS, 2015). Scott Dam is located at an elevation of 554 m (1,818 ft) along the upper mainstem Eel River at river km 260, and the study area is located in the watershed area upstream of Scott Dam (Figure 1). Lake Pillsbury, the reservoir formed by Scott Dam, accumulates water from the upper mainstem Eel River and a major tributary known as the Rice Fork, and both of these river segments receive water from many minor tributaries, making up a drainage area of about 746 km^2 (Brown and Ritter, 1986). The study area falls entirely within land federally managed by the U.S. Forest Service in the Mendocino National Forest, with the exception of some private inholdings where land use is considered either rural residential or agricultural (USDA, 2015).

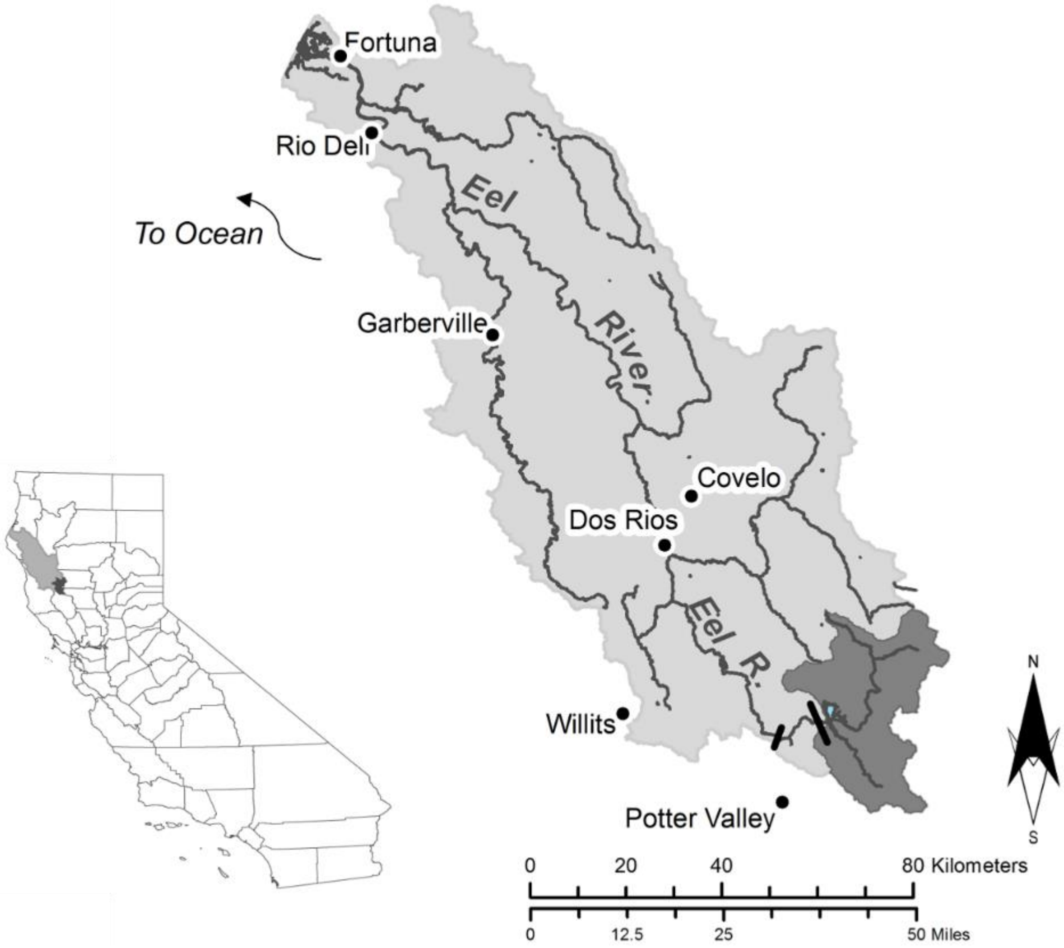

Figure 1. The study area is located in northern California denoted by the dark outline in the lower left inset. The Eel River watershed is represented by the lightly shaded area with surrounding cities labeled next to black dots. Waterways in the Eel River watershed are represented in dark gray lines. The darker shaded watershed area represents the study area. Dark lines perpendicular to the mainstem Eel River represent Cape Horn Dam and Scott Dam on the left and right, respectively. Spatial Reference: World Geodetic System 1984 (WGS84), Universal Transverse Mercator (UTM) Zone 10 North (NHD, 2016; ERCZO, 2016).

The underlying geology of the Eel River watershed consists almost entirely of the Franciscan assemblage, whose rocks are predominantly sandstone and shale (Lisle, 2013). Combinations of extreme precipitation events, steep hillslopes, and uplifting topography result in mass soil and sediment movements commonly occurring throughout the watershed (Brown and Ritter, 1986; Lisle, 2013). Compared to other rivers of similar size in the continental U. S., the Eel River has the highest sediment yield per unit area, with an estimated annual sediment load of 1720 tons/km^2 (Brown and Ritter, 1986).

The coast mountain ranges are characterized by a Mediterranean climate with extreme differences in rainfall and temperatures between seasons (Cid et al., 2017). Average annual precipitation is 120 mm, falling during winter months primarily as rain along with some snow (NOAA, 2017). Land cover includes mixed conifer forests found on north facing slopes and oak woodlands typically occurring on drier, south facing slopes.

Survey Design

Initially, the IP Model was used for determining potential distribution of Chinook Salmon and steelhead trout upstream of Scott Dam by identifying potential barriers to anadromy throughout the stream network. An area known as Bloody Rock roughs was originally identified as a migration barrier along the mainstem Eel for both Chinook Salmon and steelhead trout. Because suitable spawning and rearing habitat occurs upstream of Bloody Rock roughs, this potential barrier was evaluated using ground-based passage assessments to validate the habitat mapped in the IP Model. This potential barrier was observed by myself and another HSU student on 20 February, 2016 during high winter flows (11.50 cubic m/s, or 400 cfs, located 0.5 km downstream of the falls) with photo documentation and field measurements including vertical height, horizontal width, and depth of staging pool, using methods from Gunther et al. (2000) in the *Assessment of Fish Upstream Migration at Natural Barriers in the Upper Alameda Creek Sub-Watershed* (SFPUC, 2010; Appendix I). The site was again assessed by myself and other expert fisheries biologists from NFMS and fish passage expert Ross Taylor on 17 May, 2016 during lower flows (1.64 cms, or 58 cfs).

The stream network contained within the study site was then stratified into a total of 11 different “Reach Types” based on gradient and drainage area data derived from stream attributes in the IP model (Table 1). Stream gradient was included as a stratification variable due to its correlation with velocity, substrate composition, channel morphology, and stream habitat types; stream size measured in drainage area was included due to its correlation with channel morphology, habitat types, habitat stability, and discharge (Higgins et al., 2005). Stream gradient and drainage area categories were identified based on relationships to salmonid habitat use and geomorphology found in other studies (Higgins et al., 2005; Stillwater Sciences, 2013; Lane and Sandoval, 2014).

Table 1. Reach Type strata and their descriptions for streams in the upper mainstem Eel River upstream of Scott Dam.

Reach Type ID	Reach Type Description	Gradient	Drainage Area
1.2	Low Gradient, Small Catchment	0 - 2%	2 - 10 sq. km
1.3	Low Gradient, Medium Catchment	0 - 2%	10 - 100 sq. km
1.4	Low Gradient, Large Catchment	0 - 2%	>100 sq. km
2.1	Medium Gradient, Very Small Catchment	2 - 7%	0 - 2 sq. km
2.2	Medium Gradient, Small Catchment	2 - 7%	2 - 10 sq. km
2.3	Medium Gradient, Medium Catchment	2 - 7%	10 - 100 sq. km
3.1	High Gradient, Very Small Catchment	7 - 12%	0 - 2 sq. km
3.2	High Gradient, Small Catchment	7 - 12%	2 - 10 sq. km
3.3	High Gradient, Medium Catchment	7 - 12%	10 - 100 sq. km
4.1	Very High Gradient, Very Small Catchment	> 12%	0 - 2 sq. km
4.2	Very High Gradient, Small Catchment	> 12%	2 - 10 sq. km

After the streams were stratified into Reach Types, a randomized subsample of 25 survey locations allocated proportional to the frequency by stream length of each Reach Type was generated using a stratified, equal probability Generalized Random Tessellation Stratified (GRTS) method for a linear resource in program Rstudio version 1.0.136 with the spsurvey package (Kincaid, 2015). Five times the number of survey locations within Reach Type stratum were also assigned as oversample sites for backup.

Field surveys were conducted during the months of late June – early August 2016, following protocols adapted from California Department of Fish and Wildlife's *California Salmonid Stream Habitat Restoration Manual, Part III* (2004). Starting downstream and working in an upstream direction, each habitat unit encountered in a survey was classified as a pool, riffle, cascade, flatwater, or dry unit using a 10% sampling method derived from Hankin and Reeves (1988). The 10% sampling method required measuring all habitat variables for the first type of habitat unit encountered per ten habitat units. Repeated habitat units within a set of ten habitat units in a survey reach were only measured for length and width. A random number between one and ten was chosen, and its corresponding habitat unit in a set of ten units along a survey reach was also measured for all habitat variables. Habitat variables measured included instream cover with LWD and boulders, streambed substrate composition, canopy cover, discharge, and water quality variables such as temperature, pH, and turbidity. Each fully surveyed habitat unit was measured for length, mean wetted width, mean and maximum depth, percent canopy cover, percent cover from boulders, and received a shelter rating for cover provided by LWD. Criteria for LWD included wood that was either submerged or located within one meter of the wetted surface and at least 30 cm in diameter and three meters long. All pool habitat units were surveyed for pool tailout substrate composition via pebble counts using the Wentworth Scale, embeddedness in the pool tailout, bankfull width and depth, and temperature (Wentworth, 1992; CDFW, 2004). Substrate composition for riffles, cascades, flatwater, and dry units was estimated visually. Each type of visual estimate was conducted by the same observer for consistency when possible; otherwise, additional observers for visual estimates were calibrated to fellow observers' estimates with trial runs. Reach scale measurements were taken at the start of each habitat survey, including streamflow, temperature, pH, and a turbidity sample from the nearest upstream pool tailout area.

Analysis

Habitat data were summarized by Reach Type according to all measured variables. Analysis methods including Analysis of Variance (ANOVA), Multiple Analysis of Variance (MANOVA) and Linear Discriminant Analysis (LDA) were used to test for significant differences in the measured habitat variables and grouping among stratified Reach Types. These analyses were used to validate possible lumping of Reach Types and extrapolation of survey data onto unsurveyed streams in corresponding Reach Types.

The Unit Characteristic Method (UCM), developed by Cramer and Ackerman (2009a), is a capacity estimation model that incorporates habitat suitability indices into its functions. The core of the model multiplies a baseline standardized fish density by a measured habitat unit area, and the density values are then adjusted according to scalar values of habitat parameters (i.e. fish cover, depth, substrate, etc.) derived from habitat suitability indices (Equations 1-3, Figures 2-4) (Cramer and Ackerman, 2009b). The scalar values can be greater than one depending on the curve of the habitat parameter. The standardized fish density values specific to habitat unit types built into this model are derived from a previous study that observed juvenile salmonid densities in six Oregon streams over several years that were believed to be at maximum parr production (Johnson et al., 1993).

$$\textbf{Parr Capacity}_i = \left(\sum area_k \cdot den_j \cdot chnl_{jk} \cdot dep_{jk} \cdot cvr_{jk}\right) \cdot prod_i \qquad \textit{(Equation 1)}$$

Where;

i = stream reach. “Reach” is a sequence of channel units that compose a geomorphically homogenous segment of the stream network,
j = habitat unit type (i.e. pool, riffle, cascade, flatwater, or dry),
k = individual channel unit,
area = area (m^2) of channel unit k,
den = standard fish density (fish/ m^2) for a given species in unit type j,
dep = depth scalar with expected value of 1.0,
cvr = cover scalar with expected value of 1.0,
chnl = discount scalar for unproductive portions of large channels with expected value of 1.0, and
prod = productivity scalar for the reach, with expected value of 1.0. This scalar combines the separate effects from four additional factors defined in equation 2:

$$prod_i = turb_i \cdot drift_i \cdot fines_i \cdot pH_i \qquad \textit{(Equation 2)}$$

Where;

turb = turbidity during summer low flow (measured in NTUs),
drift = percentage of reach area in fastwater habitat types that produce invertebrates,
fines = percentage of substrate in riffles composed by fines, and
pH = pH during summer low flow;

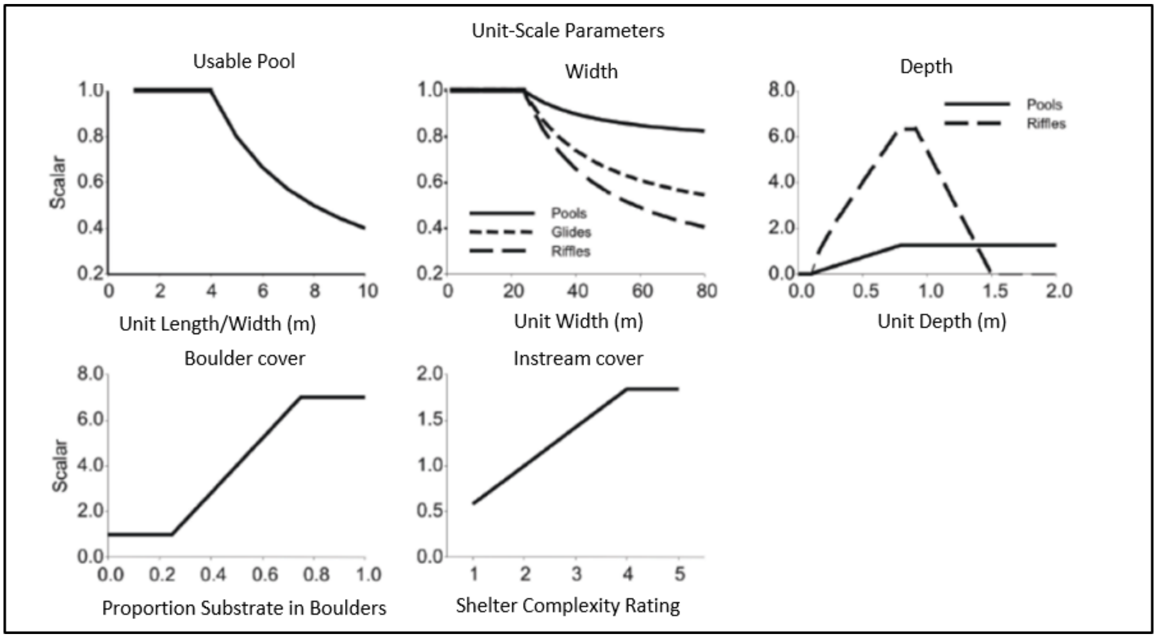

Figure 2. Habitat-parr density relationships used in unit-scale adjustments for the UCM. The y-axis represents habitat parameters in scalar values. These scalars are multiplied by parr/m^2, which adjusts the overall parr density. The Usable Pool and Width curves are used in the unit area parameter. Note that some scalar values can be greater than one. (from Cramer and Ackerman, 2009b).

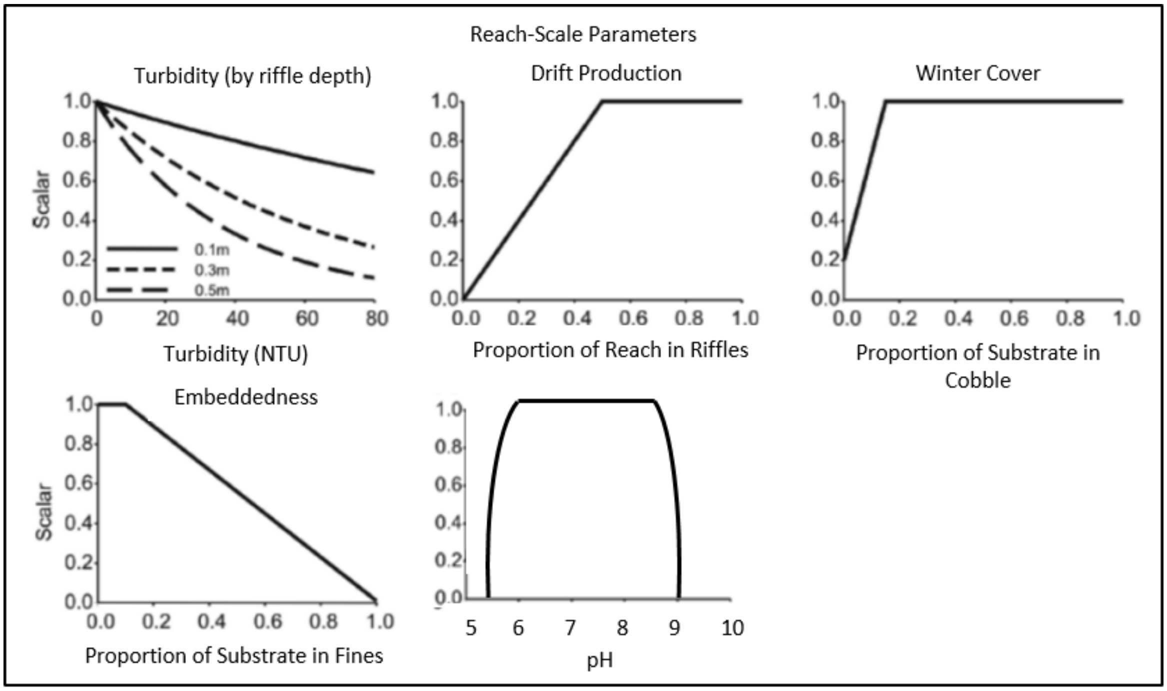

Figure 3. Habitat-parr density relationships used in the reach-scale adjustments for the UCM. The y-axis represents habitat parameters in scalar values. These scalars are multiplied by parr/m^2, which adjusts the overall parr density (from Cramer and Ackerman, 2009b and Raleigh et al., 1986).

Temperature limitations were incorporated into the model at the reach scale using limitations that Cramer et al. (2012) identified for Coho salmon. It was assumed that steelhead trout and Chinook Salmon experience similar temperature limitations for UCM analysis. A temperature-density relationship was derived from data that observed no Coho juveniles above 23 °C; the data also suggests that at 20 °C, mean parr densities were 30% of densities at optimum temperatures (Equation 3, Figure 4) (Cramer et al., 2012). The temperature scalar has a near optimum value of 0.95 at 16 °C and reduces to 0.05 at 23 °C. These temperature criteria are similar to observations from other studies on steelhead trout and Chinook Salmon temperature requirements (Myrick and Cech, 2004; Richter and Kolmes, 2006).

$$\boldsymbol{T_{si} = \frac{1}{1+e^{-a-bT}}} \qquad \textit{\textbf{(Equation 3)}}$$

where
Tsi = Temperature scalar for capacity for reach i in a given week.
a = intercept of logit(Tsi) = 19.63;
b = slope of logit(Tsi) = -0.98;
T = WAT for reach i in a given week.
This scalar is then multiplied by the habitat capacity for rearing in the reach.

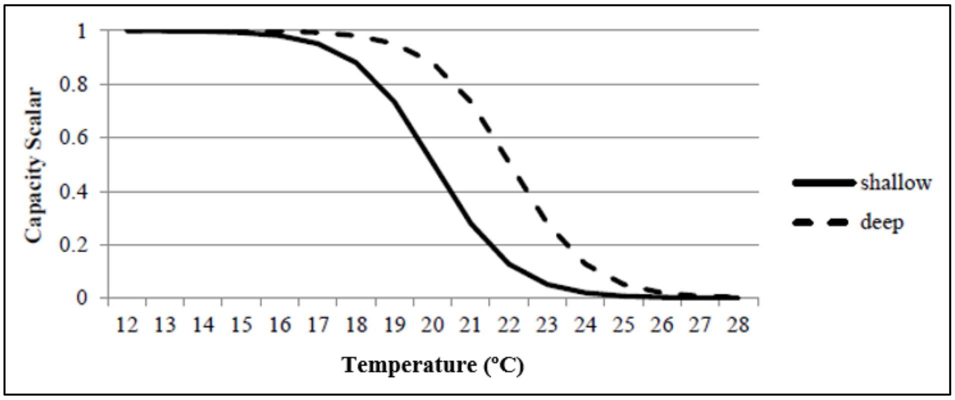

Figure 4. Effect of temperature on parr rearing capacity for Coho. Maximum Weekly Average Temperature (MWAT) is expressed as the summer maximum of the 7-day running average. Dashed line applies to pools >1m deep, which thermal stratification is assumed where a thermal refuge is provided at a depth that is 2°C cooler than surface flow (from Cramer et al., 2012).

After identifying conditions in the streams above Scott Dam as limiting to the parr life stage for each species of interest, subsequent life stages from the estimated maximum parr population were then estimated using survival rates between each life stage. This approach, similarly discussed in Rosenfeld (2003), sums composition of stream habitat units (i.e. pools, riffles, glides) multiplied by standardized densities specific to habitat units, resulting in reach-scale carrying capacity estimates that may then be summed by reach for watershed-scale capacity estimates. Despite inherent assumptions from using standardized density values derived from other watersheds, the UCM is designed to reflect local habitat conditions by using stream survey data as model inputs, which then adjust a given standard density value.

The UCM model was applied to each survey dataset by writing the appropriate functions for each unit-scale parameter and passing them through a “while loop” in program Rstudio version 1.0.136. Reach-scale adjustments were applied to the unit-scale adjustment output for each survey site in Microsoft Excel 2013. Once the UCM was applied to each survey dataset, estimated density values (parr/m^2) were averaged among survey reaches within the same Reach Type and the standard deviation of density values within a Reach Type was calculated. Remaining unsurveyed streams were assigned lengths from the IP Model, but they required wetted area in order to extrapolate the UCM parr/m^2 values. Wetted width measurements from each habitat unit were averaged among surveys in the same Reach Type and extrapolated onto unsurveyed streams of corresponding Reach Types. This met the stream area requirement for density extrapolation to calculate a watershed-scale estimate of potential density for juvenile steelhead trout and Chinook Salmon expressed in fish/m^2. The average density by Reach Type was multiplied by the total stream area of the respective Reach Type to calculate potential capacity in number of fish. The standard deviation calculated by stratified Reach Type densities reflected the range around average density values for extrapolation, and those standard deviations were passed on to capacity calculations to reflect some uncertainty around final estimates for total number of fish.

Habitat measurements were conducted during summer low-flow conditions not only for feasibility but also because these conditions typically represent the most capacity-limiting stage for steelhead trout who oversummer in streams (Cramer and Ackerman, 2009a). However, to estimate potential capacity for Chinook Salmon juveniles, survey flow conditions were converted to stream rearing conditions for Chinook Salmon, which typically peak in May. Because there are no stream gauges upstream of Scott Dam, streamflow conditions were modeled from a surrogate location in the Eel River watershed. Due to its unimpaired flows and watershed similarities to the upper mainstem Eel River, USGS mean daily flow data collected near the mouth of the Middle Fork Eel River were used. These data were arranged to plot exceedance probability by month according to timing of peak use by species and life stage (Figure 5).

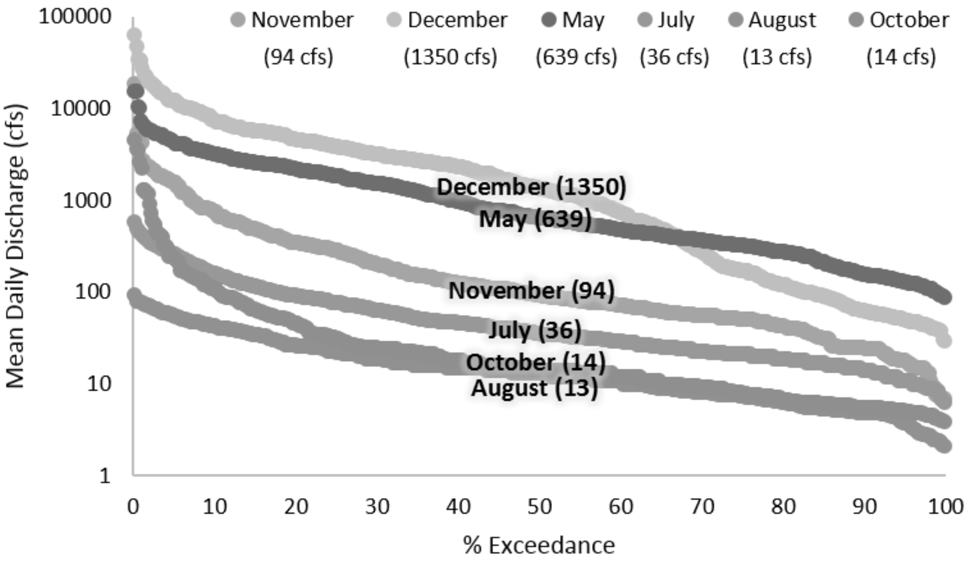

Figure 5. Exceedance probability flows from Middle Fork Eel River USGS gauge 11473900, including mean daily flow data from years 2000-2017. Fifty percent exceedance flows from select months were converted by watershed area to estimate Chinook Salmon parr rearing conditions from summer survey conditions in the upper mainstem Eel River study site.

Fifty percent exceedance flow values were then converted by drainage area to streams in the study area. Assuming 50% exceedance flows for springtime Chinook Salmon rearing, models for hydraulic geometry from Rosenfeld (2007) and described in Cramer et al. (2012) were applied to predict differences in width and depth at higher flows specific to habitat units (Figure 6).

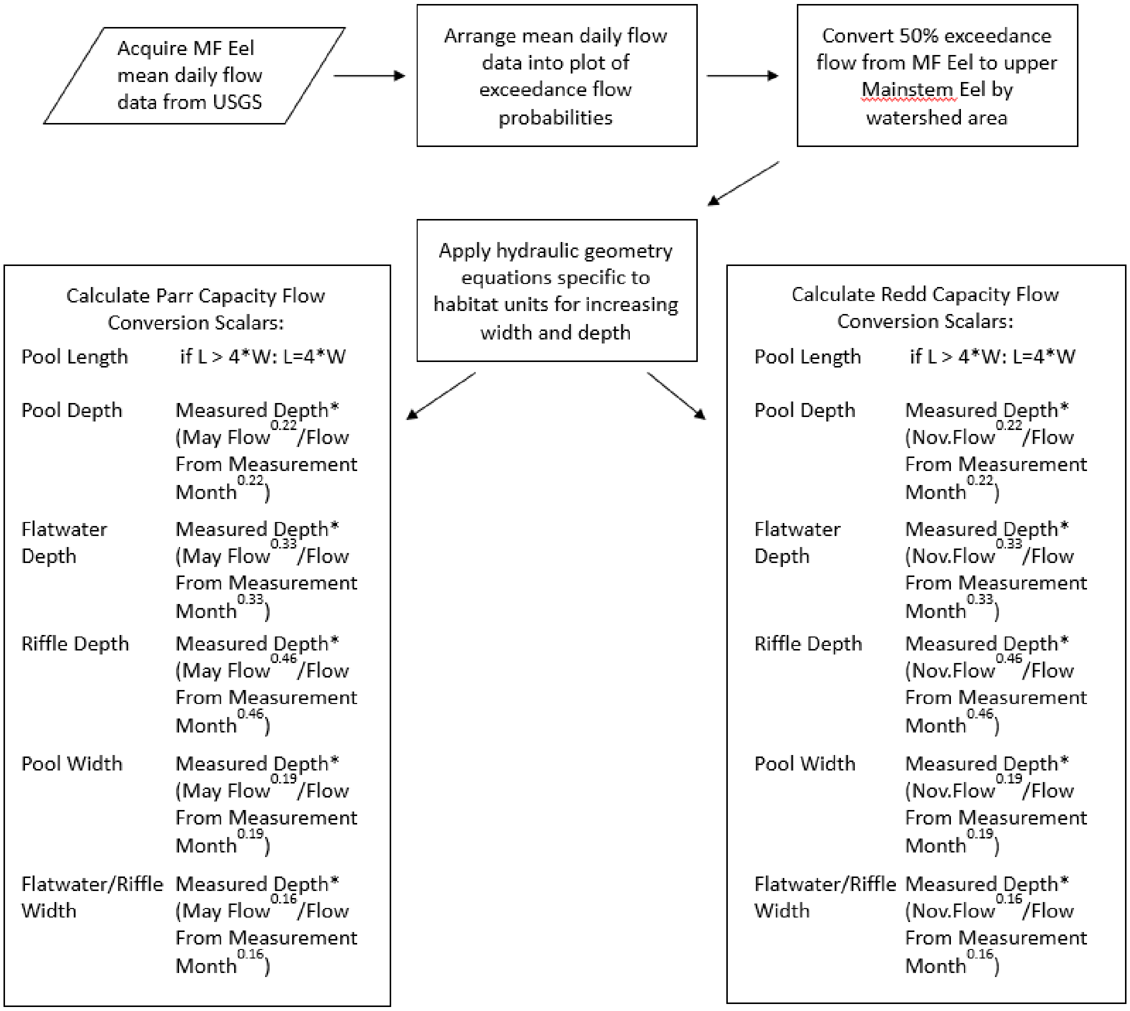

Figure 6. Flow chart of methods used to model temporal flow conditions in the upper mainstem Eel River from data in the Middle Fork (MF) Eel River. Fifty percent exceedance flows were used in conversion scalar functions. Conversion scalar functions used to scale Chinook Salmon parr and redd densities based on habitat unit types and temporal flow conditions are listed. L=unit length, W=unit width, D=unit depth. Habitat unit measurements are in meters, and flow measurements are in cfs. Pools units use maximum depth and riffles and flatwater units use mean depth (adapted from Cramer et al., 2012).

Juvenile population capacity estimates for both steelhead trout and Chinook Salmon were calculated with standardized density values specific to habitat units found in Cramer and Ackerman (2009a, b). Three applications of parameter adjustments were analyzed for parr capacity: 1) Unit-scale (i.e. usable area, depth, LWD & Boulder cover);

2) Unit & Reach-scale without drift (i.e. usable area, depth, LWD & boulder cover; turbidity, fines, pH, winter cover); and 3) Unit & Reach-scale with drift (i.e. usable area, depth, LWD & boulder cover; turbidity, fines, pH, winter cover, proportion drift habitat). The second application which excluded the drift parameter was analyzed due to the uncertain representation of proportion of riffle habitat as fish food availability. These sets of parameters were modeled to evaluate different effects on parr density estimates.

Estimates for capacity of steelhead trout and Chinook Salmon juveniles were then converted to number of spawners. The spawner conversions were calculated using different survival rates from the literature for Chinook Salmon and steelhead trout and with a set of potential life history variations for steelhead trout, and survival rate sensitivity was analyzed as varying survival rates from parr to adult found in the literature affected the overall total capacity estimates (Lister and Walker, 1966; Johnson et al., 1993; Cramer et al., 2002; Quinn, 2005; Rawding et al., 2010; Cramer et al., 2012).

In addition to modeling potential capacity at the parr life stage for both steelhead trout and Chinook Salmon, potential spawner carrying capacity was modeled to test whether suitable spawning habitat in the study site may instead be more limiting for potential production. Potential redd capacity was estimated by first modeling higher flows typical of spawning season for all survey data (with methods similar to modeling flows during Chinook Salmon parr rearing), followed by identifying spawning criteria outlined in the UCM (Table 2) (Cramer et al., 2012). Potential spawning grounds were first characterized by the presence of suitable spawning substrate with less than 40% fine substrate in each surveyed habitat unit, as outlined in the UCM redd capacity protocol

(Cramer et al., 2012). Any units that contained more than 40% fines or less than the minimum required depths were excluded. Spawnable area was calculated specific to habitat unit type and adjusted with a scalar for fines greater than 25% due to the degradation of spawning conditions where fines are more than 25% of the substrate. Once all spawning conditions were identified, the total suitable area identified among all survey habitat units was summed for the entire survey reach. Long-term studies which identified territory size for several species of salmonid spawners found that about four times the size of the redd area is required for total spawner territory area, so redd capacity was calculated by dividing the sum of total suitable spawning area by four times the average redd area for each species (Equation 4) (Burner, 1951; Keeley and Slaney, 1996; Cramer et al., 2012).

Table 2. Habitat suitability criteria used for modeling potential spawner capacity in the upper mainstem Eel River, CA. Adapted from: Cramer et al. (2012) and USFWS (2011).

Habitat Attribute	Chinook Salmon	Steelhead trout	Source(s)
Stream Gradient (%)	0 - 5	2 - 12	Merz, 2001; NMFS, 2005; Cooney & Holzer, 2006
Substrate Size (cm)	1.9 - 15.0	0.25 - 12.5	Keely & Slaney, 1996; Kondolf, 2000; USFWS, 2011
Depth (cm)	30.5	15.2	Swift 1979, USFWS, 2011
Redd Territory Area (m^2)	20.0	11.7	Burner, 1951; Keely & Slaney, 1996

Redd Capacity = Σ Qualifying Spawnable Area / (4 * Avg. Redd Area) ***(Equation 4)***

Where
Avg Redd Area is specific to a given species

Redd density was calculated by dividing the redd capacity by the total survey area with flow conditions representative of peak spawning season. Spawning capacity was calculated by assuming two spawners per redd (Grove et al., 2001; Ettlinger et al., 2015). The redd densities were averaged among surveys within a Reach Type stratum and extrapolated to corresponding Reach Type streams not surveyed. Watershed-scale redd capacity was calculated by multiplying redd densities to entire stream network where appropriate. The resulting redd capacity was compared to the spawner estimates converted from parr capacity to determine the most limiting habitat conditions for Chinook Salmon capacity in the study site.

Potential habitat distribution and capacity estimates upstream of Scott Dam were applied to three scenarios. The first scenario (Scenario 1) considers passage restoration at Scott Dam via dam removal and does not consider Bloody Rock roughs a barrier. This includes stream habitat currently inundated by Lake Pillsbury, habitat along the mainstem Eel River and its tributaries below and above Bloody Rock roughs, as well as the Rice Fork and its tributaries. The second scenario (Scenario 2) considers passage restoration via fish ladder at Scott Dam, omitting inundated streams but including all other habitat in the first scenario. The third scenario (Scenario 3) considers passage restoration at Scott Dam via dam removal with abnormally dry winter-spring conditions that would not allow passage upstream of the partial barrier at Bloody Rock roughs. Scenario 3 includes stream habitat currently inundated by Lake Pillsbury, habitat along the mainstem Eel River and its tributaries up to Bloody Rock roughs, and the Rice Fork and its tributaries.

Capacity estimates generated from UCM models were analyzed for identifying whether rearing or spawning conditions were the most limiting for capacity. The capacity limiting estimates were then compared to estimates made from past assessments. The parr capacity estimates were also spatially compared to IP scores, and the relationship between relatively high parr densities and high IP scores (IP >0.5) was modeled with Generalized Additive Modeling in program R version 1.0.136 with package mgcv. Areas of spatial overlap between high densities and high IP scores were mapped.

Finally, data from observed adults at Benbow Dam Fisheries Station (BDFS) on the South Fork Eel River were used to calculate number of fish per unit of drainage area (Yoshiyama and Moyle, 2010). Assuming these maximum recorded values represent potential capacity, or maximum density, for spawners, calculations provided fish/km^2 values that were then multiplied by the drainage area of the study area upstream of Scott Dam. Similarly, mean values of fish counts from BDFS data were also converted to fish/km^2 for a representation of potential average spawner density in the streams above Scott Dam. Additionally, fish counts at Cape Horn Dam’s Van Arsdale Fisheries Station (VAFS) located 19.3 river km (12 river mi) downstream of Scott Dam on the upper mainstem Eel River were analyzed. These data from both Benbow Dam and Cape Horn Dam fish ladders were evaluated as indices for potential spawner production in the upper mainstem Eel River upstream of Scott Dam.

RESULTS

Survey Design

Three scenarios for potential distribution of Chinook Salmon and steelhead trout in the study area streams resulted from GIS and ground-based assessments. Fish passage assessments conducted by this research at Bloody Rock roughs reclassified the roughs as a temporal barrier that both species may pass during high flows typical of upstream migration. When flow conditions are passable at Bloody Rock roughs, the potential stream habitat increased by 48% and 46% for Chinook Salmon and steelhead trout, respectively (Figure 7).

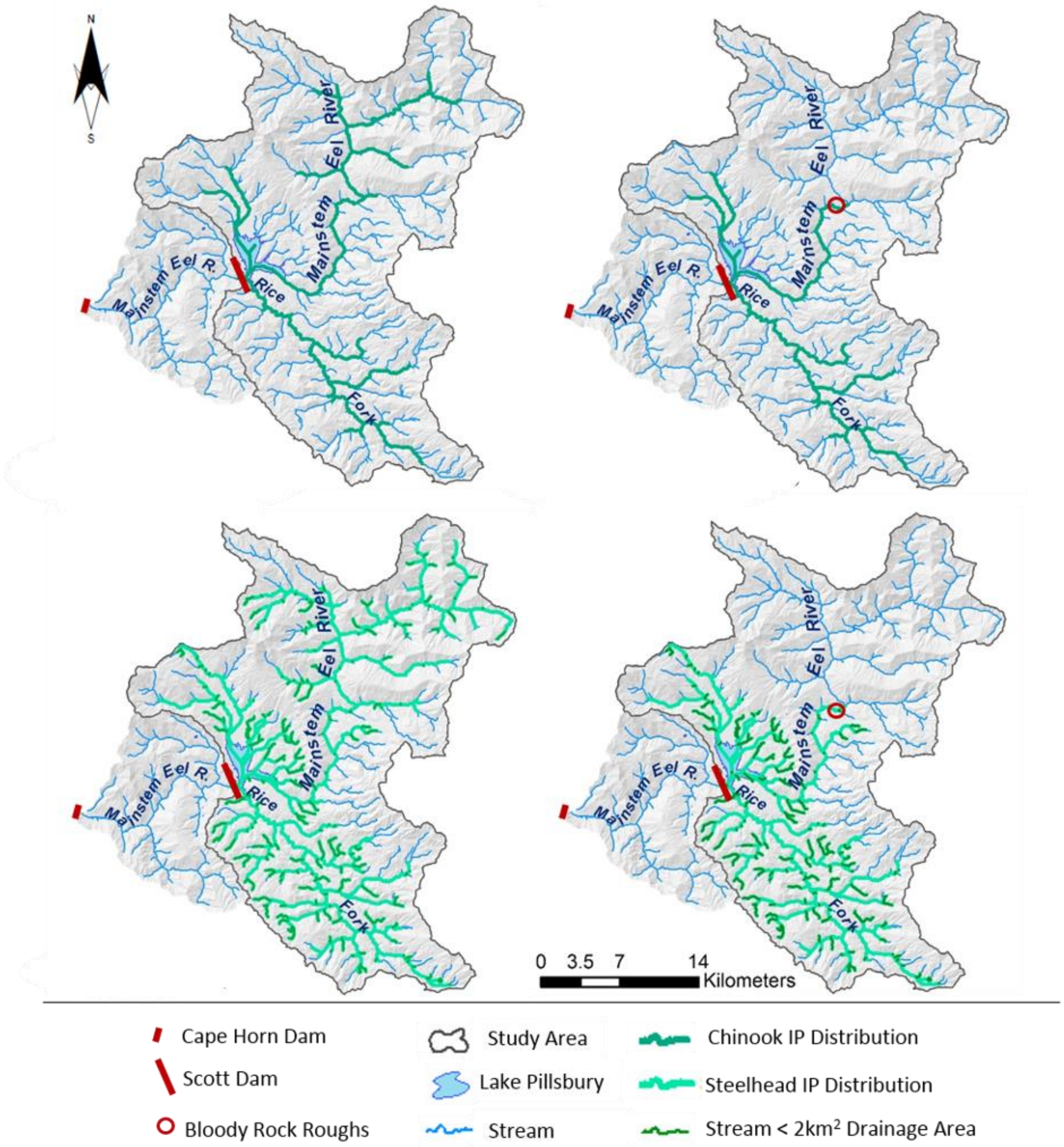

Figure 7. Intrinsic Potential distribution of Chinook Salmon (upper two maps) and steelhead trout (lower two maps) upstream of Scott Dam under two passage scenarios. The first passage scenario on the left represents removal of Scott Dam with restored access to streams above Scott Dam, including those currently inundated by Lake Pillsbury. Scenario 3 on the right represents removal of Scott Dam with restored access to streams above Scott Dam, including those inundated, but considers Bloody Rock Roughs the upper extent along the mainstem Eel River. Streams < 2km^2 depicted in lower two maps were excluded from steelhead trout parr distribution. Spatial reference: WGS 84, UTM Zone 10 North. (NMFS, 2016; National Map, 2016).

The concatenation of four incremental categories of drainage area and gradient resulted in 11 possible Reach Types in the study area streams (Figure 8). Lower gradient and large to medium-sized streams were the most common by length. Some Reach Types were excluded due to comprising such small proportions of total stream lengths in the study site. Field habitat surveys resulted in 20 wetted stream reaches totaling 13.2 stream km and 11 completely dry stream reaches totaling 6.3 stream km (Figure 8).

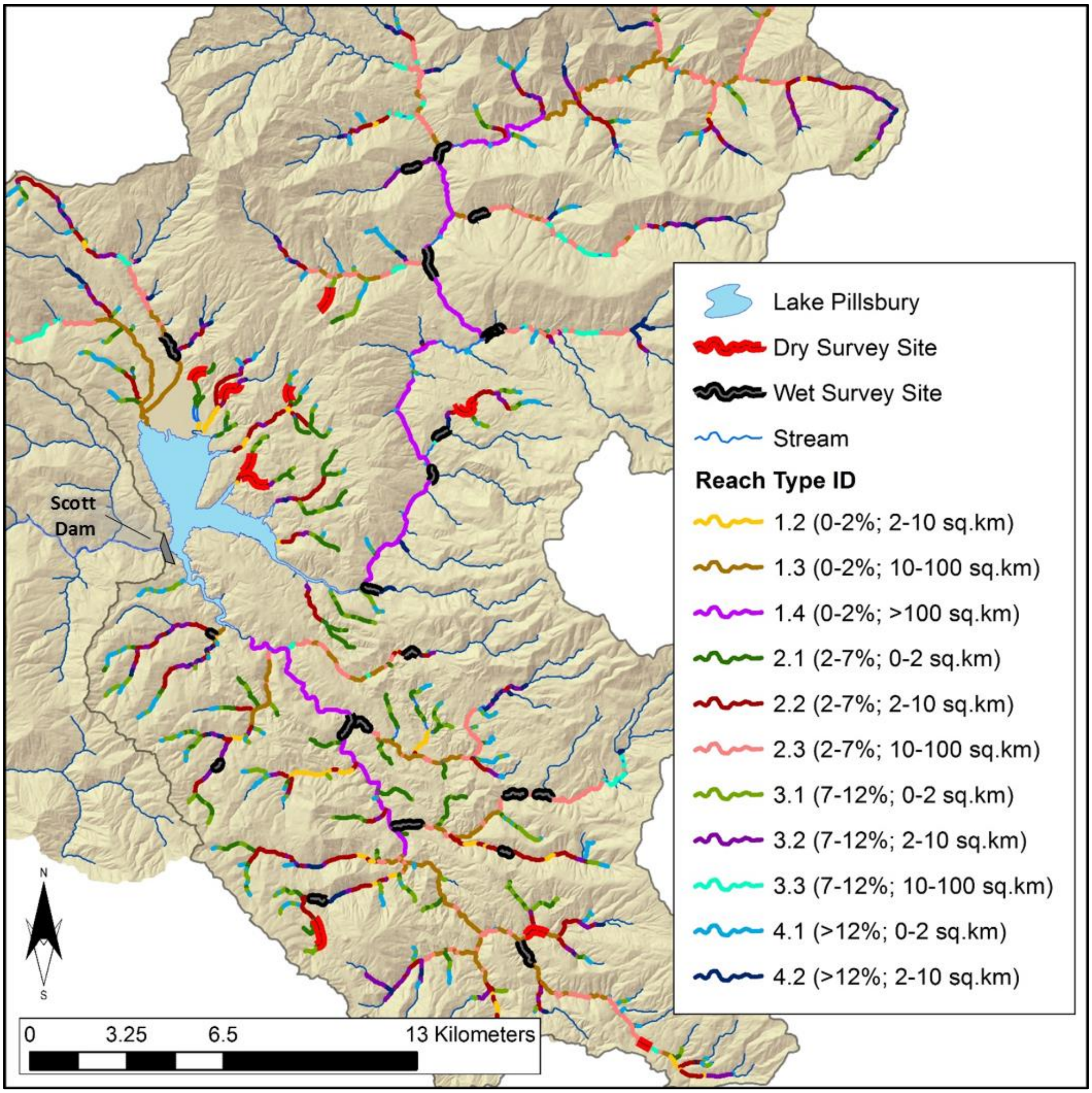

Figure 8. Spatial distribution of Reach Type stratification within the study area in the upper Eel River watershed, CA. Low Gradient, Large Catchment occurs along mainstem and lower Rice Fork; Low Gradient, Medium Catchment occurs in Corbin Creek, in tributaries north of Lake Pillsbury, and the upper Rice Fork; Low Gradient, Small Catchment occurs in smaller tributaries of the Rice Fork; Medium Gradient, Very Small Catchment occurs in small tributaries along the Rice Fork and around Lake Pillsbury; Medium Gradient, Small Catchment occurs along upper portions of large tributaries in the Rice Fork; Medium Gradient, Medium Catchment occurs in tributaries along Rice Fork and the mainstem Eel; High-Very High Gradient Reach Types are all dispersed along headwater streams throughout the watershed. Ground-based stream habitat surveys conducted during summer 2016 are represented in thick black lines for wetted habitat and thick red lines for completely dry habitat. Spatial reference: WGS84, UTM Zone 10 North (NMFS, 2016).

Potential spawning and rearing distribution for steelhead trout and Chinook Salmon was quantified under all fish passage scenarios. Other Reach Types, typically those with smaller drainage areas (<2 km^2), were observed completely without summertime surface flow and deemed unsuitable for steelhead trout summertime rearing. Consequently, these streams were excluded from potential steelhead trout rearing habitat and density estimations. Among all three passage scenarios, potential habitat distribution ranged between 291 – 463 km (181 – 288 mi) for steelhead trout and 89 – 127 km (55 – 79) for Chinook Salmon (Table 3). According to the IP Model, Scott Dam's reservoir, Lake Pillsbury, currently inundates about 27 km (17 mi) of stream habitat for steelhead trout and 16 km (10) for Chinook Salmon. In the event that the Bloody Rock Roughs becomes a barrier, 145 km of stream habitat becomes inaccessible for steelhead trout and 38 km for Chinook Salmon.

Table 3. Potential river km of habitat estimated for three scenarios in the upper mainstem Eel River.

Scenario:	1	2	3
	Removal of Scott Dam (includes waterways inundated by Lake Pillsbury)	Installation of Fish Ladder at Scott Dam to allow passage	Lower flow years when Bloody Rock roughs is a barrier to migration and limits access to upstream waterways
Chinook $\text{Salmon}_{\text{spawn}}$	127	111	89
Chinook $\text{Salmon}_{\text{rear}}$	127	111	89
Steelhead $\text{trout}_{\text{spawn}}$	463	437	318
Steelhead $\text{trout}_{\text{rear}}$	291	233	179

Analysis

Data collected during stream habitat surveys were evaluated by Reach Type with summaries of habitat unit composition as well as all other measured variables. Habitat unit composition was dominated by pools in survey reaches with a 0-2% gradient, and the proportion of fastwater habitat (riffles and cascades) was higher in reaches with gradients > 2% (Figure 9). Flatwater habitat units were nearly as frequent as pool units in low gradient reaches (0-2% gradient) and became less frequent as both gradient and drainage area increased. Other habitat variables measured in surveys were summarized by Reach Type (Table 4). Due to the large number of habitat covariates measured, multivariate analysis was necessary for further validation of Reach Type distinction for the purposes of extrapolating habitat data.

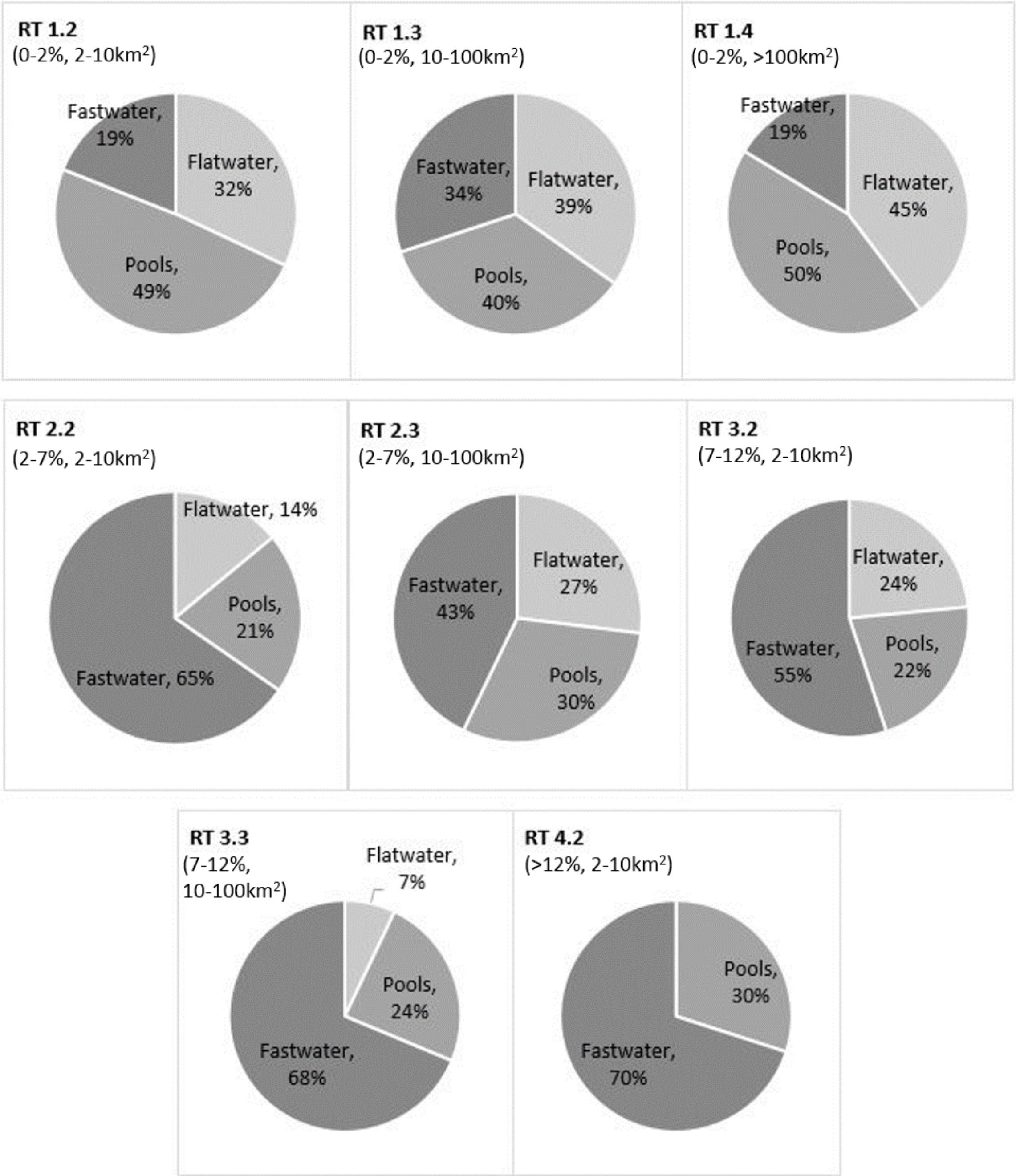

Figure 9. Habitat unit composition summarized from summer 2016 survey data among Reach Type strata in the upper mainstem Eel River, CA. Fastwater includes riffles and cascades, and flatwater includes glides and runs.

Table 4. Habitat variables measured in stream surveys conducted during summer months of 2016 in the upper Eel River watershed upstream of Scott Dam. Length, width, and depths measured in m. Values are averaged at the unit and reach scales (SD).

Reach Type	**1.2 (0-2%, 2-10km2)**	**1.3 (0-2%, 10-100km2)**	**1.4 (0-2%, >100km2)**	**2.2 (2-7%, 2-10km2)**	**2.3 (7-2%, 10-100km2)**	**3.2 (7-12%, 2-10km2)**	**3.3 (7-12%, 10-100km2)**	**4.2 (>12%, 2-10km2)**
***N* Surveys**	1	4	4	3	4	2	1	1
Total Reach Length	187	3,615	3060	1552	2545	902	528	623
Avg. Unit Wetted Width	2.26 (1.29)	3.60 (2.0)	8.67 (3.2)	2.67 (0.8)	4.15 (1.58)	2.70 (1.06)	3.60 (1.58)	1.93 (0.94)
Avg. Unit Mean Depth	0.18 (0.08)	0.23 (0.15)	0.45 (0.28)	0.25 (0.11)	0.34 (0.19)	0.27 (0.14)	0.32 (0.16)	0.20 (0.14)
Pool Max Depth	0.38 (0.09)	0.59 (0.22)	1.03 (0.55)	0.54 (0.22)	0.70 (0.36)	0.60 (0.21)	0.59 (0.22)	0.48 (0.17)
% Shelter	37% (27%)	36% (23%)	54% (19%)	48% (25%)	22% (21%)	29% (14%)	63% (25%)	31% (20%)
% Boulder Cover	0	14% (12%)	23% (19%)	21% (18%)	14% (14%)	16% (10%)	41% (23%)	24% (16%)
% Canopy	48% (34%)	49% (33%)	25% (23%)	62% (21%)	40% (38%)	74% (23%)	42% (26%)	77% (25%)
pH	6.5	7.4 (0.5)	7.7 (0.6)	7.5 (0.5)	7.3 (0.5)	6.5	8.2	6.5
Turbidity in NTU	0.7	0.3 (0.1)	2.4 (3.3)	0.6 (0.3)	0.7 (0.5)	-	1.2	0.71
CFS	0.15	2.65 (3.78)	6.25 (1.82)	1.54 (0.71)	2.92 (1.06)	0.04 (0.02)	0.63	0.05
Temperature ^{0}C	21.4 (1.4)	17.9 (3.3)	20.2 (2.8)	16.2 (1.2)	15.1 (1.2)	14.5 (0.6)	18.2 (1.3)	14.9 (1.3)
Survey Time in Hours	2.75	7.4 (1.8)	6.2 (1.8)	6.4 (1.0)	7.2 (1.4)	4.8 (0.6)	6.5	5.5

Covariates including unit area, mean depth, instream cover, percent fine substrate, and proportion of pools and fastwater habitat were analyzed in a Linear Discriminant Analysis (LDA) for discriminating groups among Reach Types with program RStudio packages Mass, GGplot2, Scales, gridExtra, and RColorBrewer (Figure 10). The first two discriminant functions explained 89% of the variability in group discrimination, and the model had an overall accuracy of 80%. The multivariate analysis of habitat covariates between Reach Types lead to lumping together select Reach Type strata, resulting in five total Reach Type categories for data extrapolation: High to Very High Gradient, Medium to Small Catchment (7-12% and >12%, 2-10 km^2 and 10-100 km^2); Low Gradient, Large Catchment (0-2%, >100km^2); Medium to High Gradient, Small Catchment (2-7% and 7-12%, 2-10km^2); Medium Gradient, Medium Catchment (2-7%, 10-100 km^2); and Low Gradient, Medium Catchment (0-2%, 10-100 km^2).

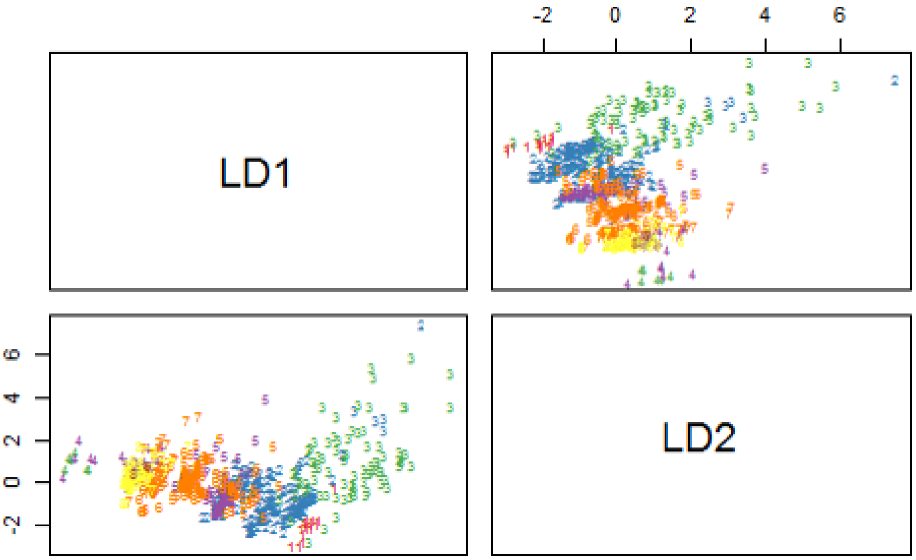

Figure 10. Linear discriminant functions 1 and 2 from the LDA model to discriminate Reach Types (represented in colors). LD1 and LD2 together explained 80 and 9% of the variability, respectively. Eight Reach Types of the highest frequency by length in the study area were surveyed and represented in this model. Note the grouping of each color in the plot, which represents the discrimination between Reach Types. Plot colored numbers represent the following Reach Types: 1= RT 0-2%, 2-10km^2; 2= RT 0-2%, 2-10km^2; 3= RT 0-2%, >100km^2; 4= RT 2-7%, 2-10km^2; 5= RT 2-7%, 10-100km^2; 6= RT 7-12%, 2-10km^2; 7= RT 7-12%, 10-100km^2; 8= RT >12%, 2-10km^2.

The UCM model adjusted steelhead trout and Chinook Salmon parr capacities using both unit-scale and reach-scale parameters measured during field surveys, and effects on model outputs were evaluated with the application of different parameters (Figures 11-14). Of the three applications of model parameters in analysis, the application including usable area, depth, LWD & boulder cover, turbidity, fines, pH, winter cover, and temperature was used. The drift parameter was eliminated due to its uncertain representation of salmonid food availability. Utilizing all parameter adjustments without the drift parameter resulted in 0.02 fish/m^2 – 0.11 fish/m^2 in Scenarios 1 & 2 and 0.01 – 0.05 fish/m^2 in Scenario 3 for steelhead trout parr (Figures

11-12). For Chinook Salmon parr, densities fell between 0.02 fish/m^2 – 0.27 fish/m^2 in Scenarios 1, 2, and 3 when densities were adjusted with all parameters except the dirft parameter (Figures 13-14).

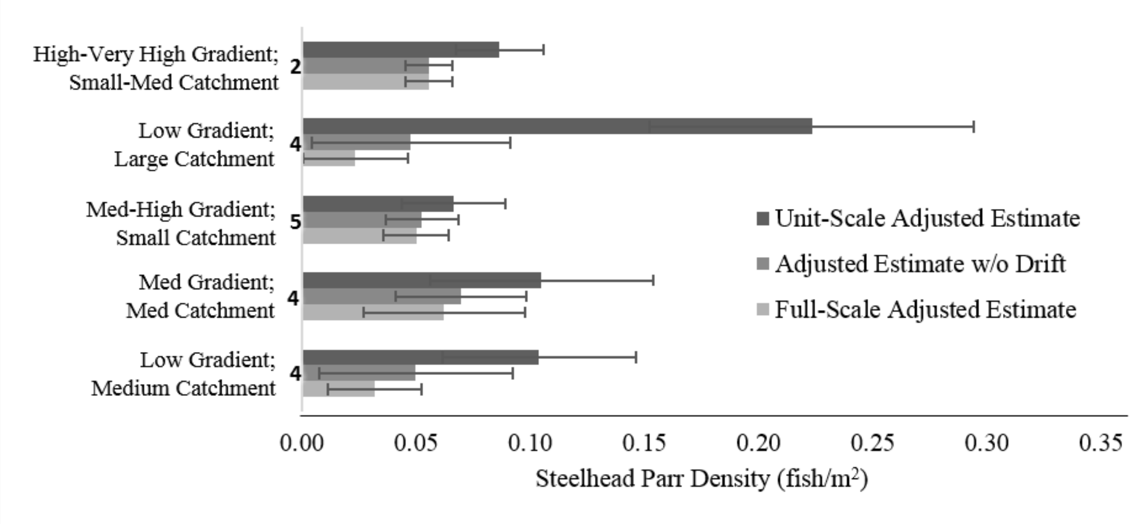

Figure 11. UCM estimated steelhead trout parr mean densities among Reach Types in the upper mainstem Eel River, CA under Scenario 1 where removal of Scott Dam restores access to habitat inundated by Lake Pillsbury, Rice Fork and its tributaries, and the mainstem Eel and its tributaries below and above Bloody Rock roughs. Unit-scale adjusted estimate includes unit-scale parameters only; adjusted estimate w/o drift includes unit- and reach-scale parameters except drift; full-scale adjusted estimate includes all unit- and reach-scale parameters. Error bars represent 1 standard deviation of reach-scale density for surveys within a Reach Type. *N* surveys denoted along y axis.

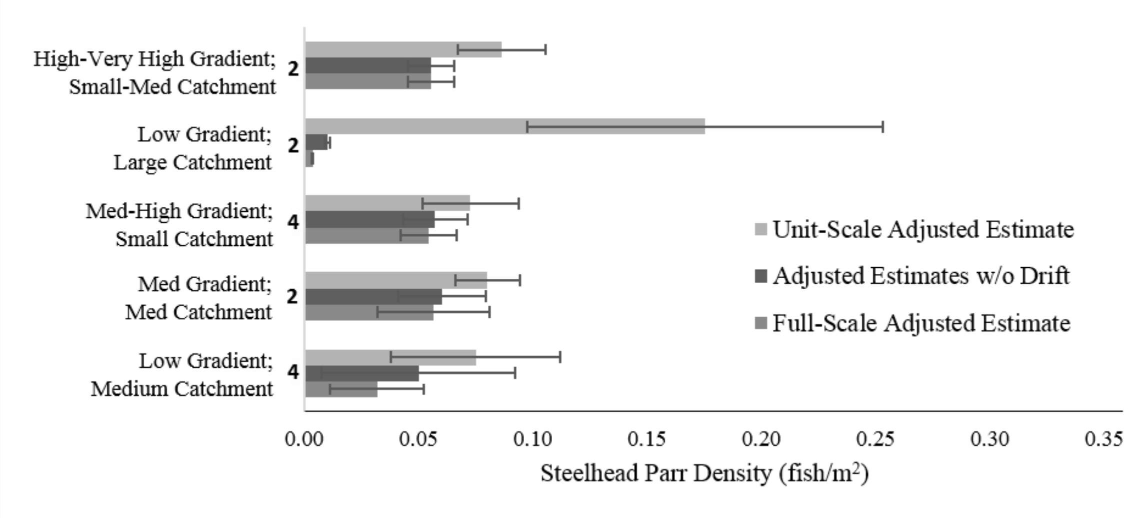

Figure 12. UCM estimated steelhead trout parr mean densities among Reach Types in the upper mainstem Eel River, CA under Scenario 3 where removal of Scott Dam restores access to habitat inundated by Lake Pillsbury, Rice Fork and its tributaries, and the mainstem Eel and its tributaries below Bloody Rock roughs. Unit-scale adjusted estimate includes unit-scale parameters only; adjusted estimate w/o drift includes unit- and reach-scale parameters except drift; full-scale adjusted estimate includes all unit- and reach-scale parameters. Error bars represent 1 standard deviation of reach-scale density for surveys within a Reach Type. *N* surveys denoted along y axis.

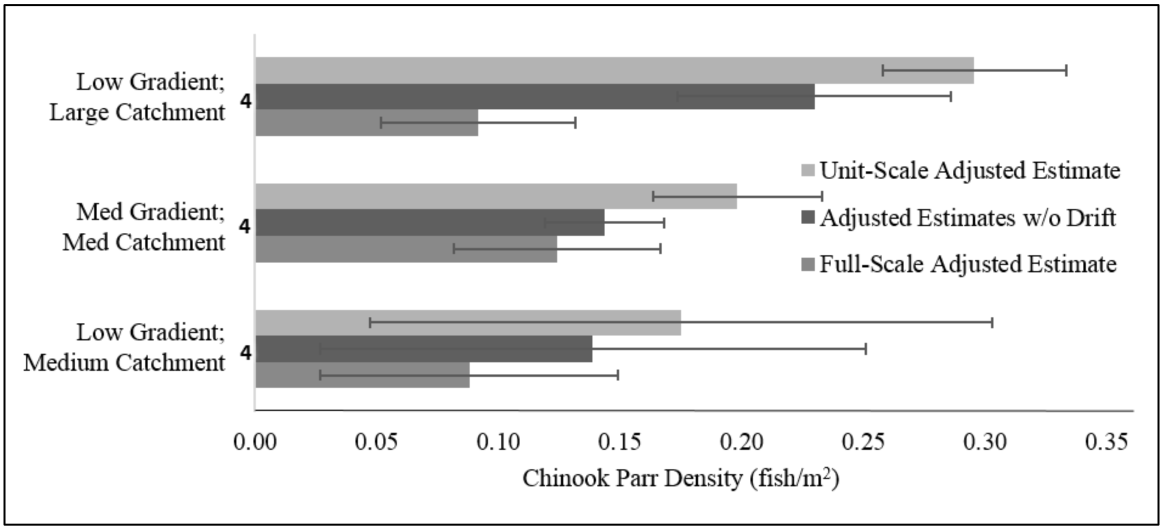

Figure 13. UCM estimated Chinook Salmon parr mean densities among Reach Types in the upper mainstem Eel River, CA under Scenario 1 where removal of Scott Dam restores access to habitat inundated by Lake Pillsbury, Rice Fork and its tributaries, and the mainstem Eel and its tributaries below and above Bloody Rock roughs. Unit-scale adjusted estimate includes unit-scale parameters only; adjusted estimate w/o drift includes unit- and reach-scale parameters except drift; full-scale adjusted estimate includes all unit- and reach-scale parameters. Error bars represent 1 standard deviation of reach-scale density for surveys within a Reach Type. *N* surveys denoted along y axis.

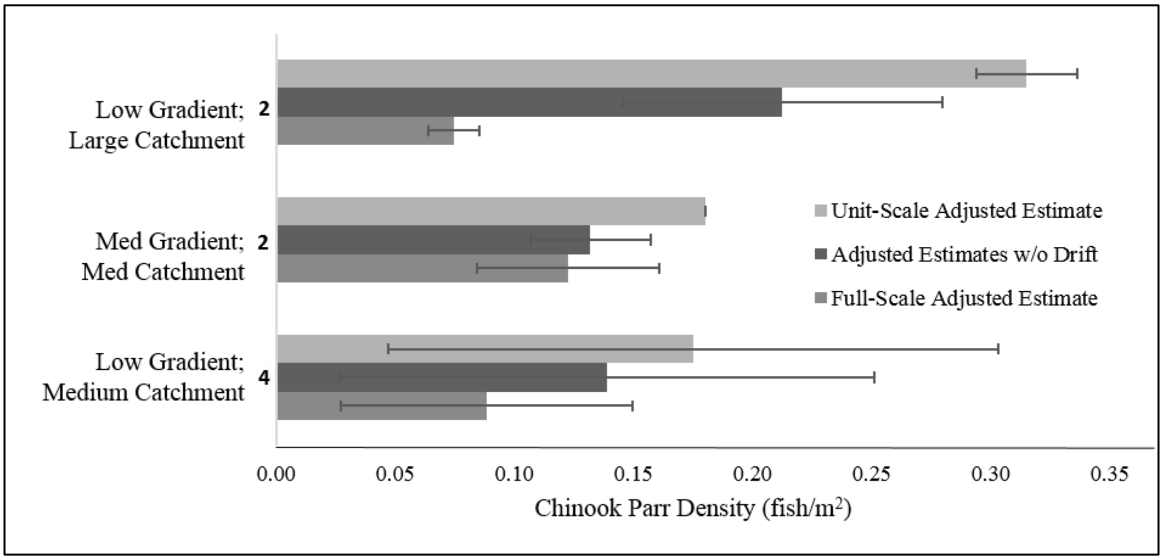

Figure 14. UCM estimated Chinook Salmon parr mean densities among Reach Types in the upper mainstem Eel River, CA under Scenario 3 where removal of Scott Dam restores access to habitat inundated by Lake Pillsbury, Rice Fork and its tributaries, and the mainstem Eel and its tributaries below Bloody Rock roughs. Unit-scale adjusted estimate includes unit-scale parameters only; adjusted estimate w/o drift includes unit- and reach-scale parameters except drift; full-scale adjusted estimate includes all unit- and reach-scale parameters. Error bars represent 1 standard deviation of reach-scale density for surveys within a Reach Type. *N* surveys denoted along y axis.

Mean densities among Reach Types in Scenarios 1 and 2 did not differ, but the capacity outputs were slightly different due to the difference in total habitat area. Extrapolating densities stratified by Reach Type for Scenario 1 resulted in a capacity of 57,374 steelhead trout parr and 201,426 Chinook Salmon parr at the watershed scale. For steelhead trout parr, Scenario 1 estimates were decreased by about 10% and 40% in Scenarios 2 and 3, respectively (Table 5). Chinook Salmon parr estimates from Scenario 1 were decreased by about 20% and 32% in Scenarios 2 and 3, respectively (Table 6).

Table 5. Steelhead trout parr stratified mean densities generated by the UCM, along with length of habitat by Reach Type streams that fall within steelhead trout parr habitat. Steelhead trout parr capacity is shown in mean stratified density (1SD) and recruited spawners reflect watershed-scale estimate for each scenario.

	Scenario 1		**Scenario 2**		**Scenario 3**	
	Removal of Scott Dam (includes waterways inundated by Lake Pillsbury)		Installation of Fish Ladder at Scott Dam to allow passage		Lower flow years when Bloody Rock roughs is a barrier to migration and limits access to upstream waterways	
	Mean Density (fish/m^2)	Stream Habitat (km)	Mean Density (fish/m^2)	Stream Habitat (km)	Mean Density (fish/m^2)	Stream Habitat (km)
RT 1.3	0.05	48.9	0.05	48.9	0.05	36.757
RT 2.3	0.07	51.6	0.07	51.6	0.06	27.505
RT 3.2 & 2.2	0.06	97.1	0.06	97.1	0.06	72.757
RT 1.4	0.05	61.9	0.05	34.9	0.01	22.861
RT 3.3 & 4.2	0.06	31.7	0.06	31.7	0.06	18.555
Total Stream km		291.2		232.5		178.435
Parr Capacity	57,374 (SD 32,081)		49,858 (SD 25,497)		27,848 (SD 9,982)	
Spawners Recruited from Parr Capacity with 13% ocean survival	1,044-2,088*		907-1,815*		507-1,014*	

*Range reflects differing survival rates based on proportion of cohort that emigrates at different ages.

Table 6. Chinook Salmon parr mean densities generated by the UCM and length of habitat by Reach Type streams that fall within Chinook Salmon parr habitat. Chinook Salmon parr capacity is shown in mean stratified density (1SD) and recruited spawners reflect watershed-scale estimate for each scenario.

	Scenario 1		**Scenario 2**		**Scenario 3**	
	Removal of Scott Dam (includes waterways inundated by Lake Pillsbury)		Installation of Fish Ladder at Scott Dam to allow passage		Lower flow years when Bloody Rock roughs is a barrier to migration and limits access to upstream waterways	
	Mean Density (fish/m^2)	Stream Habitat (km)	Mean Density (fish/m^2)	Stream Habitat (km)	Mean Density (fish/m^2)	Stream Habitat (km)
RT 1.3	0.14	40.7	0.14	40.7	0.14	29.3
RT 2.3	0.15	35.6	0.15	35.6	0.13	20.5
RT 1.4	0.23	50.9	0.23	34.9	0.21	38.9
Total Stream km		127.2		111.2		88.7
Parr Capacity	201,426 (SD 67,550)		160,322 (SD 55,295)		65,200 (SD 18,901)	
Spawners Recruited from Parr Capacity with 3% ocean survival	4,593		3,655		1,487	

Using life stage-specific survival rates for each species, the parr estimates in each scenario were converted to spawners. Survival rates for steelhead trout conversions varied based on proportion of cohort that emigrates as either parr or smolts (Table 7) (Johnson and Cooper, 1995; Cramer et al., 2012). A survival rate of 28% for steelhead trout parr to smolt was used and a range of smolt to adult survival rates including 1.5%, 13%, and 20% were used to estimate spawner recruits from juvenile capacity estimates (Table 6) (Johnson and Cooper, 1995; Cramer et al., 2003; Quinn, 2005; Cramer et al., 2012; Anderson and Ward, 2016). For Chinook Salmon, a survival rate of 76% from parr to smolt was used and a range of smolt to adult survival rates including 1.5%, 3%, and 4% were used to estimate spawner recruits from juvenile capacity estimates (Table 8) (Quinn, 2005; Rawding et al., 2010; Cramer and Ackerman, 2012; Moore et al., 2014; Anderson and Ward, 2016).

Table 7. Watershed-Scale capacity estimate for juvenile steelhead trout under Scenario 1 where removal of Scott Dam restores access to habitat inundated by Lake Pillsbury, Rice Fork and its tributaries, and the mainstem Eel and its tributaries below and above Bloody Rock roughs in the upper mainstem Eel River, CA, and its conversion to number of adults based on survival rates for each life stage between parr and adult. Ocean survival rates (smolt to adult) from various sources were analyzed.

Steelhead trout Juvenile Survival Rate Conversion to Spawners from a Parr Capacity of 57,374 fish

Parr to Smolt Survival 28%	Additional Year of Rearing Survival 50%		Smolt to Adult Survival 1.5% (Cramer and Ackerman, 2012)	Smolt to Adult Survival 13% (Quinn, 2005; Anderson and Ward, 2016*)	Smolt to Adult Survival 20% (Moore et al., 2014)
16,065	100% Smolt age 2+ outmigration	8,032	120	1,044	1,606
	75% Smolt age 2+ outmigration	10,040	151	1,305	2,008
	50% Smolt age 2+ outmigration	12,049	181	1,566	2,410
	25% Smolt age 2+ outmigration	14,057	211	1,827	2,811
	100% Parr age 1+ outmigration	16,065	241	2,088	3,213

*Steelhead trout and Chinook Salmon ocean survival calculated from Freshwater Creek smolt abundance divided by adult abundance from years 2007-2015 resulted in an average 13% steelhead trout ocean survival rate.

Table 8. Watershed-Scale capacity estimate for juvenile Chinook Salmon under Scenario 1 where removal of Scott Dam restores access to habitat inundated by Lake Pillsbury, Rice Fork and its tributaries, and the mainstem Eel and its tributaries below and above Bloody Rock roughs in the upper mainstem Eel River, CA, and its conversion to number of adults based on survival rates for each life stage between parr and adult. Ocean survival rates (smolt to adult) from various sources were analyzed for converting number of spawners from a parr capacity estimate of 201,426 fish.

Parr to Smolt Survival 76%	Smolt to Adult Survival 1.5% (Rawding et al., 2010)	Smolt to Adult Survival 3% (Quinn, 2005)	Smolt to Adult Suvival 4% (Anderson and Ward, 2016*)
153,084	2,296	4,593	6,123

*Steelhead trout and Chinook Salmon ocean survival calculated from Freshwater Creek smolt abundance divided by adult abundance from years 2007-2015 resulted in an average 4% Chinook Salmon ocean survival rate.

Parr densities averaged among Reach Types were assigned to all stream segments that compose lumped Reach Type strata in the study area and mapped for streams under the fish passage scenario where Scott Dam is removed and there is passage at Bloody Rock roughs. The highest stratified mean density values (0.07 parr/m^2) for steelhead trout occurred in tributaries of the mainstem Eel River as well as in tributaries of the Rice Fork (Figure 15). For Chinook Salmon, highest stratified mean density values (0.21 parr/m^2) occurred along the mainstem Eel River and lower reaches of the Rice Fork (Figure 15). Throughout the entire study area stream network, there were 210 stream km with a stratified mean density value of 0.05 parr/m^2, about 30 stream km with a mean density of 0.06 steelhead trout parr/m^2, and there were 50 stream km with the highest steelhead trout mean density at 0.07 parr/m^2. For Chinook Salmon, stratified mean densities of 0.13, 0.14, and 0.21 parr/m^2 each occurred in ~50 stream km of the study area stream network. Spatial overlap where estimated parr densities were relatively high and IP scores were >0.5 was mapped and plotted (Figures 16-17).

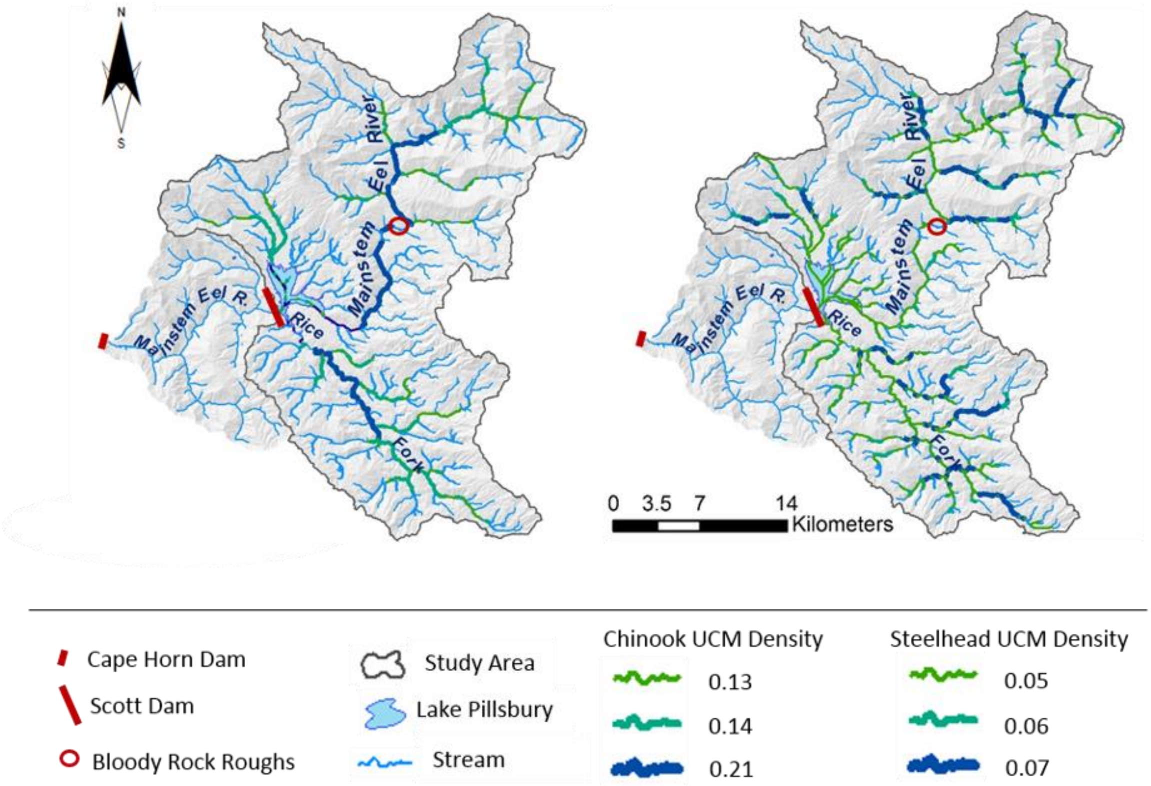

Figure 15. Spatial distribution of juvenile Chinook Salmon (left) and steelhead trout (right) densities estimated for stratified Reach Types in the Upper Eel River, CA. Higher capacity densities are represented with larger, darker stream lines. The spatial reference is WGS84, UTM Zone 10 North (National Map, 2016; USGS, 2016; Esri, USGS, NOAA, 2016).

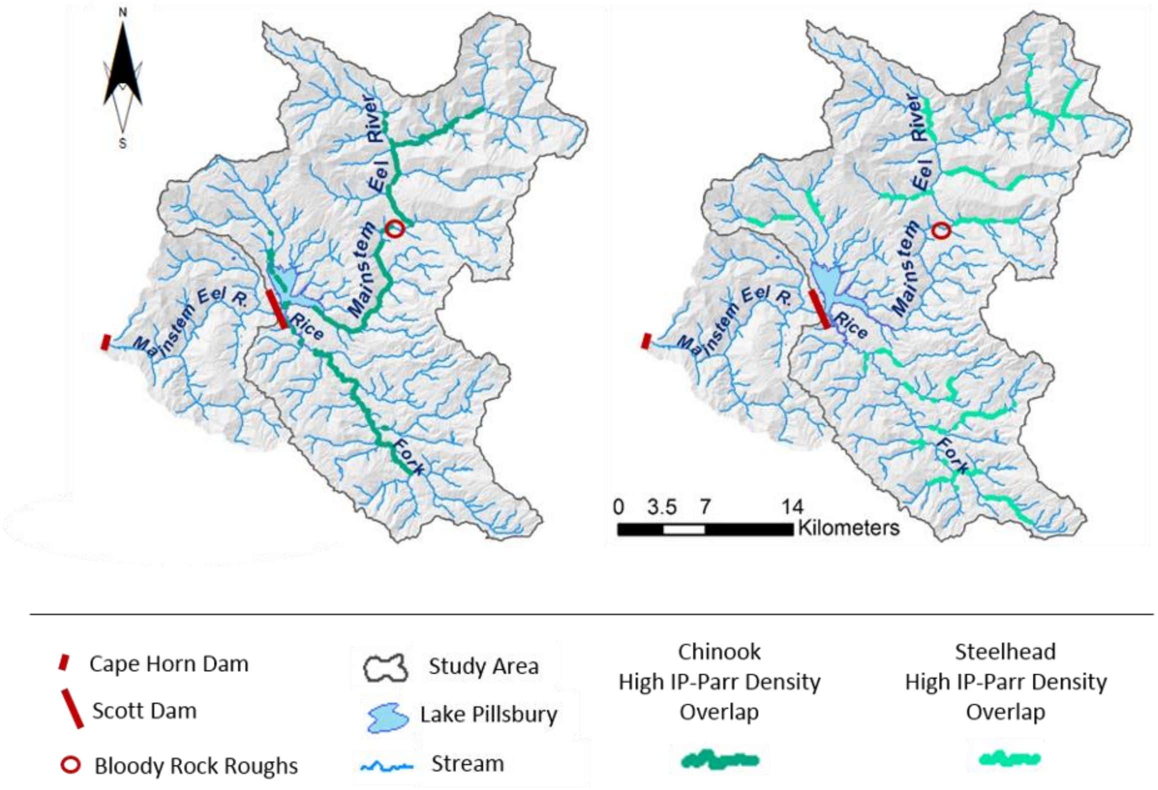

Figure 16. Spatial overlap of high IP scores (>0.5) and relatively high parr density values for Chinook Salmon (left; density >0.13) and steelhead trout (right; density >0.05) in the upper mainstem Eel River, CA. Spatial reference is WGS84, UTM Zone 10 North (National Map, 2016; USGS, 2016; NMFS, 2016).

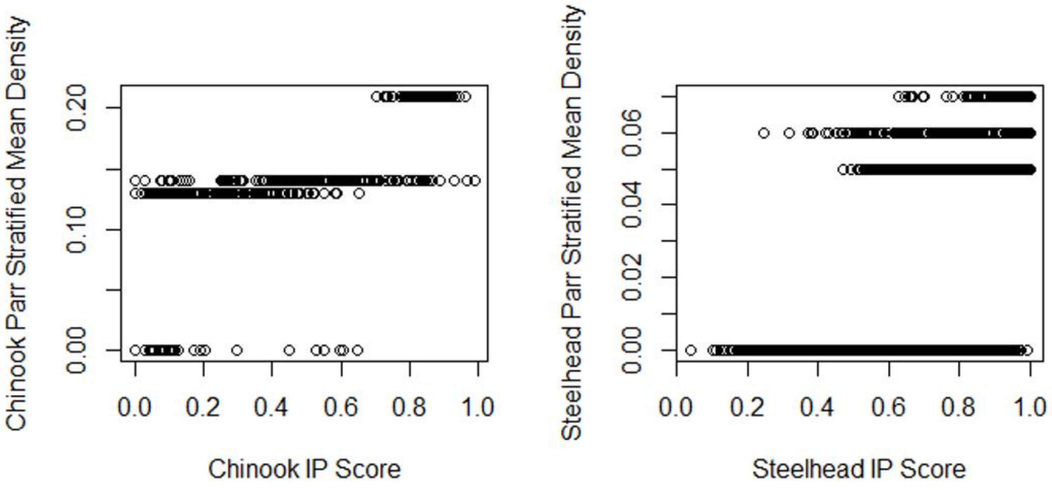

Figure 17. Plotted data for stratified mean density values of Chinook Salmon (left) and steelhead trout (right) parr in response to IP score in the upper mainstem Eel River, CA (NMFS, 2016).

The response curve of potential density in relation to IP score was analyzed with Generalized Additive Models (GAMs). A positive relationship between the predictor and response variables was expected. Several GAMs were modeled by manipulating the gamma value, and the most appropriate models for both steelhead trout and Chinook Salmon resulted in what appeared to be a positive linear relationship (Table 7 and Figure 18). The GAM for parr density in response to IP score explained 54% of the deviance for steelhead trout and 72% of the deviance for Chinook Salmon.

Table 9. Generalized Additive Models and their respective complexity and performance values for modeling the response of predicted parr density values with IP score in the upper mainstem Eel River watershed, CA. One model per species was selected based on performance where overfitting did not appear to occur and where the expected positive relationship was reflected in the plotted curve.

	Gamma	**Deviance Explained**	**AIC**
Chinook Salmon$_{GAM1}$	1.4	79%	-9,906
Chinook Salmon$_{GAM2}$	10	79%	-9,886
Chinook Salmon$_{GAM3}$	100	77%	-9,623
Chinook Salmon$_{GAM4}$	145	72%	-9,148
Steelhead trout$_{GAM1}$	1.4	56%	-26,213
Steelhead trout$_{GAM2}$	10	56%	-26,198
Steelhead trout$_{GAM3}$	40	56%	-26,018
Steelhead trout$_{GAM4}$	65	54%	-25,974

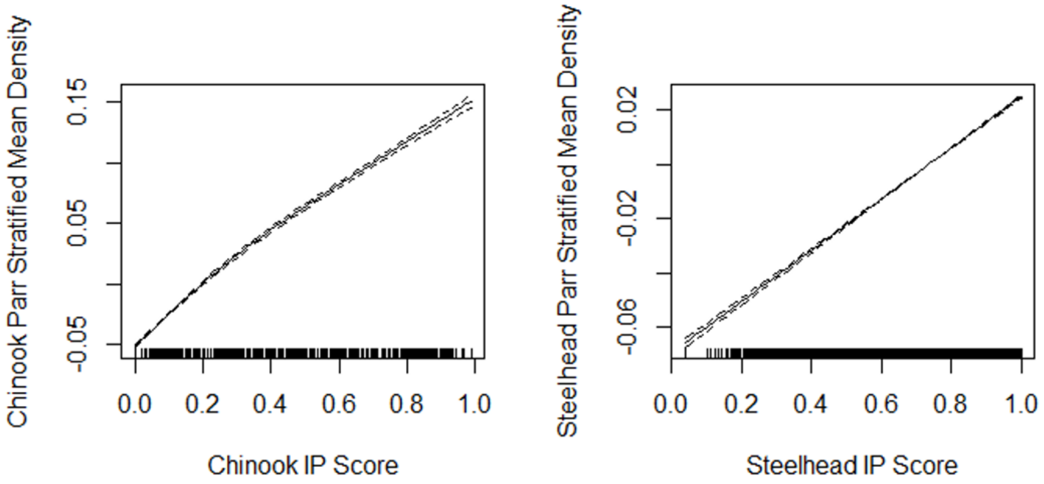

Figure 18. Generalized Additive Models of parr density in response to IP score for Chinook Salmon and steelhead trout. Chinook Salmon GAM deviance explained was 72% (gamma=145, AIC=-9148) and steelhead trout GAM deviance explained was 56% (gamma=10, AIC=-25,974). Dashed lines represent 95% confidence interval.

Habitat field data, flows modeled for the month of November, and spawning criteria were used to estimate a Chinook Salmon redd capacity of about 7,600 – 11,460 redds for the entire watershed area of the study site, depending on the fish passage scenarios. Spawner densities ranged from 60 – 80 fish/km^2, and spawner capacity resulted from the assumption of two spawners per redd (Table 10) (Grove et al., 2001; Ettlinger et al., 2015).

Table 10. Chinook Salmon redd and spawner capacity generated from UCM redd capacity model for three fish passage scenarios in the upper mainstem Eel River watershed. Redds were estimated from mean density values among stratified Reach Types (1SD of stratified densities).

		Chinook Salmon Redds	**Chinook Salmon Spawners**
Scenario 1	Removal of Scott Dam (includes waterways inundated by Lake Pillsbury)	11,460 (SD 9,232)	22,900
Scenario 2	Installation of Fish Ladder at Scott Dam to allow passage	9,285 (SD 7,172)	18,570
Scenario 3	Removal of Scott Dam; in lower flow years when Bloody Rock roughs is a barrier to migration	7,600 (SD 4,434)	15,200

Parr estimates from the UCM and their subsequent spawner recruits were used to compare to spawner estimates from past assessments (Tables 11-12). Assessments in the past estimated potential abundance upstream of Scott Dam for Chinook Salmon and steelhead trout spawners based on spawner data from other areas of the Eel River (CDFG, 1979; VTN, 1984; BLM, 1995; Becker and Reining, 2009; Higgins, 2010; NMFS, 2016; PVID, 2017). Additionally, annual fish counts for migrating adults at Van Arsdale Fisheries Station (VAFS) located upstream of the fish ladder at Cape Horn Dam were analyzed over the past 80 years for steelhead trout and 70 years for Chinook Salmon as an index for number of spawners entering the accessible streams within the Potter Valley Project (PVID, 2017). Adult counts at VAFS ranged from 31 – 9,528 steelhead trout, averaging 1,835 fish and between 0 – 3,471 Chinook Salmon, averaging 366 fish. Adult counts at Benbow Dam Fisheries Station (BDFS) on the South Fork Eel River from years 1938 – 1975 ranged from 1,847 – 25,032 steelhead trout, averaging 11,192 fish, and 473 – 21,011 Chinook Salmon, averaging 6,998 fish. Counts at BDFS are on average higher than those from VAFS in part due to the larger watershed area above BDFS. These data from BDFS converted to about 9.9 steelhead trout adults/km^2 and 6.2 Chinook Salmon adults/km^2, converting to about 7,400 steelhead trout adults and 4,620 Chinook Salmon adults potentially supported in the 746 km^2 of drainage area above Lake Pillsbury.

Table 11. Potential steelhead trout stream habitat and abundance estimates from past reports compared to those from this report in the upper mainstem Eel River watershed, CA.

Steelhead trout Habitat in Stream-km	**Steelhead trout Spawner Abundance**	***Source***
-	2,500	CDFG, 1979, unpublished
94	1,499	VTN, 1982
160		BLM, 1995
411	-	Becker and Reining, 2009
463	6,120	NMFS, 2016
-	408	PVID, 2017*
318 - 463	1,044-2,088	This research via UCM**
-	7,400	This research via conversion of spawner count data from Benbow Dam

*Includes estimates of spawners using stream habitat between Van Arsdale and Scott Dam only. PVID (2017) is an average of upstream migrant counts from 2000-2016 at Van Arsdale Fisheries Station.
**Includes estimates of spawners recruited from capacity estimate of 57,374 parr converted with a 28% parr to smolt survival rate and 13% ocean survival rate.

Table 12. Potential Chinook Salmon stream habitat and abundance estimates from past reports compared to those from this report in the upper mainstem Eel River watershed, CA.

Chinook Salmon Habitat in stream-km	**Chinook Salmon Spawner Abundance**	***Source***
-	2,300	CDFG, 1979, unpublished
94	1,250	VTN, 1982
160		BLM, 1995
-	3,092	Higgins, 2010*
127	2,060	NMFS, 2016
-	917	PVID, 2017*
89 - 127	4,593	This research via UCM**
-	4,620	This research via conversion of spawner count data from Benbow Dam

*Includes estimates of spawners using stream habitat between Van Arsdale and Scott Dam only. PVID (2017) is an average of upstream migrant counts from 2000-2016 at Van Arsdale Fisheries Station. Higgins (2010) reflects abundance estimate for habitat between dams from year 2010.
**Includes estimates of spawners recruited from capacity estimate of 201,426 parr converted with a 76% parr to smolt survival rate and 3% ocean survival rate.

DISCUSSION

Summary of Findings

Three fish passage scenarios were used to estimate the amount of potential stream habitat suitable for Chinook Salmon and steelhead trout in the upper mainstem Eel River upstream of Scott Dam. The first scenario (Scenario 1) includes passage at Scott Dam via dam removal and does not consider Bloody Rock roughs as a migrational barrier. Scenario 1 resulted in 127 km for Chinook Salmon spawning and rearing and a potential Chinook Salmon juvenile capacity of 201,426 parr which converted to about 4,593 Chinook Salmon spawners using mid-range smolt to adult survival rates. Scenario 1 resulted in 463 km for steelhead trout spawning and 291 km for steelhead trout rearing, with a potential capacity of about 57,374 steelhead trout parr and about 1,044 – 2,088 steelhead trout spawner recruits from parr capacity, depending on age of emigrants and using mid-range smolt to adult survival rates. Under the second scenario (Scenario 2), fish passage at Scott Dam is restored via fish ladder installation and Bloody Rock roughs is considered passable, so streams inundated by Lake Pillsbury are excluded. This resulted in a reduction of potential stream habitat (due to inundation by Lake Pillsbury) from Scenario 1 by about 27 km for steelhead trout with a parr capacity of 49,858 fish and about 907 – 1,815 steelhead trout spawner recruits from parr capacity, depending on age of emigrants and using mid-range smolt to adult survival rates. Scenario 2 resulted in a reduction of 16 stream km for Chinook Salmon from the first passage scenario, and parr capacity estimates were 160,322 parr and about 3,655 Chinook Salmon spawner recruits from parr capacity using mid-range smolt to adult survival rates. The third passage scenario (Scenario 3) includes passage at Scott Dam via dam removal, but considers Bloody Rock roughs a barrier for anadromy in drier years. This resulted in about a 30% reduction in potential stream spawning and rearing habitat for Chinook Salmon, about a 30% reduction in potential steelhead trout spawning habitat, and about 40% less stream habitat for potential steelhead trout rearing habitat. Steelhead trout parr capacity estimates for Scenario 3 resulted in about 27,848 parr and about 507 – 1,014 steelhead trout spawners recruited from parr capacity, depending on age of emigrants and using mid-range smolt to adult survival rates. Chinook Salmon parr capacity was estimated at 65,200 parr, and 1,487 Chinook Salmon spawners were recruited from parr capacity using mid-range smolt to adult survival rates.

Although there was not much difference in potential salmonid habitat capacity for salmonids between the first two passage scenarios, fish passage at Bloody Rock roughs did make a considerable difference in both habitat conditions and their capacity for salmonids. Habitat upstream of Bloody Rock roughs includes tributaries along the mainstem Eel where potential rearing capacities were at their highest densities for steelhead trout, so this lack of a considerable amount of quality stream habitat contributed to the larger difference observed in the scenario where Bloody Rock roughs is a barrier. Another factor that contributed to the lower potential capacity in the scenario where Bloody Rock roughs is not passable was unsuitable temperature for rearing salmonids. Streams in the Reach Type stratum Low Gradient, Large Catchment (0-2%, >100 km^2)

had a mean steelhead trout parr density of 0.05 in both scenarios where passage occurs at Bloody Rock roughs, but when the roughs are a barrier, mean steelhead trout parr density was 0.01. For Chinook Salmon, passage at Bloody Rock roughs makes a significant difference due to both quantity (38 km) and quality of stream available for spawning and rearing upstream of the roughs.

The potential fish passage scenarios used in this study include scenarios similar to what was found in past assessments. Venture Tech Network (1984) considered Bloody Rock roughs impassable, which is comparable to the third scenario in this study where the roughs are also not considered passable. However, this study considers blocked passage at Bloody Rock roughs atypical. The first two scenarios where passage at Bloody Rock roughs is allowed are therefore considered more likely, and the estimated amounts of habitat are similar to what was found from Becker and Reining (1999).

Rearing capacity for both Chinook Salmon and steelhead trout was determined more limiting than potential spawner capacity, so subsequent spawner recruits from parr capacities were used for comparing to abundance estimates from other sources. Chinook Salmon estimates generated from the UCM (4,593 spawners) were higher than all other estimates found from past assessments including those from CDFG (1979) at 2,300 spawners, VTN (1984) at 1,250 spawners, and NMFS (2016) at 2,060 spawners. Steelhead trout spawners recruited from UCM parr capacity estimates ranged between 1,044 – 2,088, which was comparable to VTN (1984) estimate of 1,499 spawners and CDFG (1979) estimate of 1,500 spawners but lower than NMFS estimate of 6,120 spawners. Upstream migrant fish counts at Van Arsdale Fisheries Station (VAFS) were averaged from the past 70-80 years as available. The counts at VAFS provided an index for salmonid production in streams between Van Arsdale and Scott Dam, and UCM-generated capacity estimates were compared by calculating potential increase in production from VAFS counts. While the VAFS counts were a useful comparison tool, the interannual variability among count data was high, so maximum potential increases generated from UCM capacity estimates would likely be variable. Further, converting the predicted parr to number of subsequent adults suggested a need for more accurate life stage specific survival rates that are representative of the upper Eel River watershed, especially for smolt to adult survival.

Streams that had both high estimated parr densities and high IP scores were identified. For both Chinook Salmon and steelhead trout, the highest stratified mean parr densities occurred only at higher IP scores, but lower estimated densities for steelhead trout occurred across the entire range of IP scores. The inconsistencies between parr densities and IP scores were analyzed with GAMs, and most of the variability for potential density in response to IP scores was explained for steelhead trout and Chinook Salmon. These areas of overlap occurred in tributaries of the mainstem Eel River mostly upstream of Bloody Rock roughs and along tributaries of the Rice Fork for steelhead trout. For Chinook Salmon, areas of overlap between high IP scores and high stratified densities occurred along the mainstem Eel and lower, larger catchment reaches of the Rice Fork. Cramer and Ackerman (2009b) suggest considering such instances of overlap as areas for conservation. In response, streams qualified for conservation upstream of Scott Dam warrant the need to restore salmonid access due to their high intrinsic and production potential. Spatial overlap between high UCM parr capacities and high IP scores for steelhead trout also occurs, but is less associated.

Assessment of Survey Design and Habitat Capacity Models

Although there was some overlap in the measured habitat characteristics among Reach Type strata after performing analyses of variance and discriminant analyses on the habitat covariates, it was apparent that utilizing gradient and drainage area as the initial distinguishing features for stratifying the study site streams was effective. Streams surveyed in Reach Type stratum Low Gradient, Large Catchment (0-2%, >100 km^2) were consistently the most distinguished by habitat variables among streams in all other strata. Although geomorphic covariates such as depth, wetted width, and unit composition tended to be more distinguished among strata, there were other habitat covariates such as embeddedness and percent fish cover that varied both within and among reaches. This ultimately created variation in the UCM-generated density values within surveys of a Reach Type.

Overall, the reach-scale adjustments in the UCM reduced parr capacity the most. Temperature in the UCM is the most restrictive parameter for steelhead trout parr capacity, which is reflective of studies that have found summertime rearing conditions to be the most limiting for juvenile salmonids (Cramer & Ackerman, 2009a). Rearing habitat conditions for steelhead trout parr were most unsuitable in lower gradient, large drainage area streams, typically occurring along the mainstem or lower reaches of the Rice Fork. Summer temperatures exceeding suitable conditions (>18 ºC) were observed in some areas of these streams, and this resulted in reduced capacity potential for over-summering steelhead trout. The temperature aspect of the UCM model separates it from other approaches such as those made by CDFG (1979), VTN (1984), and the NMFS IP Model (2016), which may be why the UCM estimates for steelhead trout are considerably low compared to other estimates made in the past (Table 9). Furthermore, survey data used in UCM estimates for this research reflect conditions after multiple years of drought, which may have also contributed to lower flows and warmer temperatures and thus lower estimates of capacity. UCM parr estimates for Chinook Salmon, however, fall within or close to past estimates. Chinook Salmon rearing conditions that peak in May are not subject to high temperatures, so potential capacity for Chinook Salmon parr was highest in reaches along the mainstem Eel and Rice Fork, which are typical-sized reaches for Chinook Salmon parr occupancy (Quinn, 2005). Chinook Salmon parr densities were also not as sensitive to other small-scale adjustments in the UCM model, which may explain why Chinook Salmon estimates are closer to those from the past that were based on a more large-scale habitat parameter approach.

The productivity scalar in the UCM model had a limiting effect on potential parr capacity for both species, namely due to unsuitable proportion of fish food-producing drift habitat. It was uncertain how effectively the drift parameter represents fish food availability, so estimates were modeled without the drift parameter. For both steelhead trout and Chinook Salmon parr capacity, the highest estimates were calculated from surveys in Cold Creek and upper Bear Creek in Reach Type stratum Moderate Gradient, Medium Catchment (2-7%, 10-100 km^2). The streams in this Reach Type were characterized by a high riffle-pool ratio and ample base streamflow with maximum temperatures observed below 17 ºC.

There are significant discrepancies between the UCM for parr capacity versus redd capacity. Redd capacity estimates result in a spawner capacity up to ten times the spawners that would be recruited from the parr capacity. This suggests that rearing conditions in the study site are more limited for salmonid production than spawning conditions. In response, the spawners derived from parr capacity estimates were applied for comparison to past assessments. Spawner estimates converted from parr capacities were put into context with a comparison to spawner counts at Van Arsdale Fisheries Station (VAFS) at Cape Horn Dam located downstream of Scott Dam. After calculating number of fish per drainage area from maximum spawner counts at Benbow Dam on the South Fork Eel River and applying that value to the drainage area of the study site, spawners recruited from UCM parr capacity were lower for steelhead trout but similar for Chinook Salmon. Under the scenario with dam removal where fish passage allows access to streams above Scott Dam including those inundated as well as passage at Bloody Rock roughs, the average spawner population entering VAFS from the past 16 years could increase up to 5.0 times for Chinook Salmon and up to 5.1 times for steelhead trout, assuming parr abundances reach full capacity and mid-range ocean survival. Likewise, there are potential increases up to 4.0 times for Chinook Salmon and up to 4.4 times for steelhead trout in the scenario with passage restoration via fish ladder at Scott Dam, and up to 1.6 times for Chinook Salmon and up to 2.5

times for steelhead trout in the scenario with passage restoration via dam removal and no passage at Bloody Rock roughs.

The potential increase in salmonid production in the upper mainstem Eel River also depends on many other factors, including downstream habitat and population conditions. Upon reintroduction of salmon and steelhead trout, UCM redd capacity results show that streams above Scott Dam would provide ample habitat for spawning, which suggests opportunity for subsequent saturation of the stream seedbank for egg recruits. Due to there being more potential spawning than rearing habitat for both Chinook Salmon and steelhead trout in the streams above Scott Dam, juvenile capacity estimates from the UCM model suggest that a proportion of the recruits from a fully seeded spawning population would have to seek habitat elsewhere, migrating downstream of Scott Dam. Such juvenile movement in response to instream rearing conditions was observed among Chinook Salmon in the Shasta River, CA (Roddam and Ward, 2015). Recent monitoring efforts from Higgins (2010) show it is typical that salmonid abundance does not reach capacity in upper Eel River streams between Scott and Cape Horn Dam in the PVP as well as downstream of the PVP, therefore potentially allowing habitat to be utilized by emigrants produced in the streams above Scott Dam. Although salmonid density may not reach capacity upon recolonization in streams above Scott Dam, restoring access to the habitat is likely to increase current salmonid production in the upper Eel River, thereby aiding in recovery goals for fisheries management.

Uncertainty and Improvements

A model has been described as a set of rules that relates quantities in the model to observations made, yet there are inherent restrictions within a model's representation of a given universal phenomenon (Hawking, 1988). It is important to understand that like all models, the approach and findings in this research have some levels of uncertainty that affect the overall outcomes. The conversion of parr estimates to spawners was highly sensitive to life stage-specific survival rates, which were derived from various literature sources (Johnson et al., 1993; Quinn, 2005; Rawding et al., 2010; Cramer et al., 2003, 2012; Moore, 2014; Anderson and Ward, 2016). Survival rates are dependent upon highly variable factors found in marine and stream conditions as well as the density of previous generations as found in stock-recruitment curves, yet stock-recruitment curves are highly variable and can be unreliable for making predictions (Zhou, 2007). Steelhead trout express over 30 anadromous life history strategies (Moore et al., 2014). Estimates generated from this research used a subset of freshwater rearing life histories including some typical for steelhead trout juveniles throughout the conversions from estimated steelhead trout parr to adults. A more robust representation of the freshwater rearing strategies including juvenile movement through space and time may result in different estimates for subsequent adult numbers. Further, emigration conditions for downstream movement of juvenile salmonids affects growth rate up to smoltification, and smolt body size upon entering the ocean has been observed to have a positive relationship with number of returning adults (Koenings et al., 1993; Ward and Slaney, 1988; Ward et al., 1989). Consequently, assuming a uniform size and therefore uniform survival rate across all parr or smolts modeled from the UCM may result in an underestimation of potential number of returning adults. Smolt to adult survival should be reflective of smolt size and age, which can be measured by identifying the difference in size of emigrants in upper reaches of a watershed versus emigrant size upon ocean entry. This information could provide insight to potential improvements needed for downstream migration stream conditions such as those stream conditions within and downstream of the PVP in the mainstem Eel River. Because the magnitude of change in smolt to adult survival rate is considerably related to salmonid production, identifying potential improvements to smolt to adult survival may play an important role in increasing salmonid production in the upper mainstem Eel River (Petrosky et al., 2001). Additionally, Chinook Salmon parr estimates are subject to uncertainty in the assumption that May rearing conditions are at 50% exceedance flows. Unimpaired springtime runoff is typically high, as it is influenced by rainfall and snowmelt. However, a model that includes a more detailed reflection of temporal flow variation in response to precipitation conditions may affect the resulting Chinook Salmon parr estimates (Asarian, 2016).

Due to limited time, survey access, and funding, the habitat dataset used to model fish estimates was limited. Extrapolation of stream width measurements onto unsurveyed streams in the study area resulted in variable watershed-scale stream area, and all capacity estimations were sensitive to changes in usable area conditions.

Further, density values among reaches within the same Reach Type were variable, and this resulted in wide ranges of watershed-scale estimates for both parr and redd capacity.

Monte Carlo simulations with distributions around each parameter value would reveal model sensitivity for better quantification of model uncertainty. Quantification of field tool and observation error may be analyzed with injecting noise into all measured habitat variables as model inputs and running many iterations of those noise-injected variables with a Monte Carlo simulation. The UCM capacity outputs were highly dependent upon the standardized, static density values built into the model. Experimenting with a distribution of density values specific to habitat unit types in a Monte Carlo simulation would reveal the sensitivity of this parameter. Additionally, the habitat scalar curves associated as average habitat conditions for each model parameter assume that fish respond the same to habitat conditions throughout all streams. Injecting noise into the equations of these curves, or essentially changing the “average” habitat conditions and how they relate to fish density, may quantify even more model uncertainty.

A larger number of surveys among stratified Reach Types over several survey seasons would likely improve multivariate analyses and representation of study area for extrapolation purposes. These would be further improved with a higher resolution DEM (1m resolution) from which to generate and characterize stream conditions including stream length as well as width. Further, high resolution DEMs may offer a more accurate, three-dimensional approach. The core capacity measure in the UCM multiplies density values by area; possible improvements to salmonid habitat models may instead utilize volume of a habitat unit for measuring capacity. This may be done by making small-scale adjustments to capacity with other habitat conditions, similar to the UCM approach, but also by simulating varying discharge conditions, as done by Ayllon et al (2012). Additionally, capacity modeling would be improved by including inter- and intra-specific competition relationships as well as a bioenergetics component that is reflective of food availability in the study site. However, because body size is considered the strongest determinant for potential abundance more so than other factors such as competition and food availability, estimating capacity in response to available habitat area, as in the UCM, is a justifiable approach (Grant and Kramer, 1990; Keeley and Grant, 1995; Keeley and McPhail, 1998).

Finally, efforts to validate the UCM model in the upper Eel River should be carried out. This should be done by conducting habitat assessments along with fish monitoring so that UCM predicted densities can be compared to observed densities. Observed densities and their relationship to model habitat parameters can be utilized for manipulating habitat scalar curves to be more representative of observed relationships in the Eel River.

CONCLUSIONS

Through a review of past and current methods for estimating potential salmonid habitat and production in the upper mainstem Eel River watershed along with ground-based surveys, potential distribution of Chinook Salmon and steelhead trout in the waterways upstream of Scott Dam was identified, and potential production under three scenarios was estimated. The habitat in the upper mainstem Eel River watershed provides cold water refugia in tributaries over summertime for steelhead trout as well as ample amounts of spawning grounds suitable for both Chinook Salmon and steelhead trout. The UCM provided a useful interpretation of habitat conditions and how they relate to potential salmonid capacity in the streams above Scott Dam. This research’s modeling approach allowed for both the quantity and quality of potential habitat to be identified and mapped. However, there is room for improvement not only for understanding production response upstream of Scott Dam, but also production response downstream of the dam in the event of dam removal or adaptive flow management.

Restoring access to the habitat upstream of Scott Dam would increase exposure to unique environmental conditions which support localized adaptations and life history plasticity within upper Eel River populations that are important to the long-term persistence of pacific salmonids (Spence et al., 2008). Considering the level of population decline and habitat degradation in the Eel River, reintroduction to the habitat above Scott Dam would likely increase salmonid production, especially for Chinook Salmon, aiding in the recovery of upper mainstem Eel river populations.

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APPENDIX A

Appendix A: Reach Stratification for a GRTS survey design

1. Designate range categories in Microsoft Excel. For this, the only attribute collumns needed include: object ID, mean gradient, area (km^2), gradient category, area category, and reach type ID
    a. Gradient:
        i. 0-2%
        ii. 2-7%
        iii. 7-12%
        iv. >12%

        =IF(B2<0.02,1,IF(B2<0.07,2,IF(B2<0.12,3, IF(B2<20,4))))

    b. Drainage Area (km^2):
        i. 0-2
        ii. 2-10
        iii. 10-100
        iv. >100

        =IF(C2<10,1, IF(C2<100,2, IF(C2<250, 3, IF(C2<100000,4))))

    c. Combine gradient and area categories into one column of values: =CONCATENATE(D2,".", E2)

    d. IP score Category
        i. 0-0.33 low
        ii. 0.33-0.66 medium
        iii. 0.66-1 high

        =IF(E2<0.33,1,IF(E2<0.66,2,IF(E2<1,3)))

    e. Convert concatenated values into numbers, make new file with ObjectID, Reach Type ID, and IP Cat columns for joining to attribute table in ArcMap

2. Join excel file to attribute table of shapefile in ArcMap

   a. Open ArcMap, right click IP streams layer, click joins and relates
   b. Join attributes from a table, choose field as "OBJECTID"
   c. Browse for appropriate excel file (StrataJoinTable.xls)
   d. Double check attribute table to make sure it worked

3. Add XY coordinates to attribute table
   a. Open attribute table
   b. Top left icon drop down
   c. Add field > Name: Start_X,
   d. Type: Double > click OK
   e. Rt click new column in att. Table > Calculate Geometry > yes
   f. Property: Y (or X) coordinate of line start
   g. Use coordinate system of data source
   h. Repeat starting from c. for Start_Y coordinate

4. Export into new shapefile
   a. "U:\ejc485\Master's Thesis\GRTS\GRTS_Streams_1"
   b. "U:/ejc485/Master's Thesis/GRTS/GRTS_Streams_1"

5. Translate spatial data into R
   a. Open .R code in RStudio
   b. Use proper file path and file name for code
      i. To copy file path: shift + rt click folder with shapefiles in it and click "copy as path" –Then you can paste wherever you want
   c. Change backslashes to forward slashes for R code (see 4.b.)
   d. Run the code after installing all packages

6. Run GRTS
   a. Generate lengths table, which will give you output of lengths of each Reach Type
      i. Copy the output, save to .txt or .csv file, convert to .xlsx file
      ii. Identify proportion of Reach Type occurrence in stream data frame

APPENDIX B

Appendix B: R code for GRTS stratified, equal probability with an oversample survey design

```
install.packages("rgdal")
install.packages("rgeos")
install.packages("geosphere")
install.packages("raster")
install.packages("spdep")
install.packages("spsurvey")

library(sp)
library(rgdal)
library(spsurvey)

# The first argument is the name of the directory where the data is
# stored. If your data is already in the R working directory, just use
# '.'. The second argument is the name of the shapefile without the
# extension (.shp)
pts <- readOGR("U:/ejc485/Master's Thesis/GRTS/GRTS_Streams_1_1",
"GRTS_Streams_1_1", verbose = FALSE)
lin <- readOGR("U:/ejc485/Master's Thesis/GRTS/GRTS_Streams_1_1",
"GRTS_Streams_1_1", verbose = FALSE)

#Plotting spatial data
maxXY<- pmax(bbox(pts)[,2], bbox(lin)[,2], bbox(pol)[,2])
minXY<- pmin(bbox(pts)[,1], bbox(lin)[,1], bbox(pol)[,1])
plot(pol, xlim = c(minXY[1], maxXY[1]), ylim = c(minXY[2], maxXY[2]))
plot(lin, add = TRUE)
plot(pts, add = TRUE)


###########################################

##View data frame
View(lin)
View(pts)
```

```
sp2shape(sp.obj=lin, shpfilename="GRTS_Streams_1")

att=read.dbf("GRTS_Streams_1")   #read attribute table from shapefile
head(att)  #display initial six lines in attribute data frame

#display number of stream segments cross-classified by the strata (combos) and
#multidensity (IP) categories
TypeVsIPTable=addmargins(table("Reach Type"=att$REACH_TYPE_ID, "IP
score"=att$IP_CAT))
TypeVsIPTable

#display sum of lengths among each Reach Type
ReachTypeLengths=tapply(att$LENGTH, list(att$REACH_TYPE_ID), sum)
ReachTypeLengths


#summarize frame stream length by stratum and multidensity category
lengths<-tapply(att$LENGTH, list(att$REACH_TYPE_ID, att$IP_CAT), sum)
lengths

lengths=lengths[,c("1","2","3")]
lengths

lengths=na.omit(lengths)
lengths

lengths=addmargins(lengths)
lengths

lengths<-round(lengths,2)
lengths

names(dimnames(lengths))<-list("Reach Type", "IP score")
lengths
```

```
##############################
#Stratified, equal probability GRTS survey design with an oversample

#create the design list
stratdsgn<-list(
                    "1.1"=list(panel=c(PanelOne=0), seltype="Equal", over=0),
                    "1.2"=list(panel=c(PanelOne=2), seltype="Equal", over=10),
                    "1.3"=list(panel=c(PanelOne=3), seltype="Equal", over=15),
                    "1.4"=list(panel=c(PanelOne=3), seltype="Equal", over=15),
                    "2.1"=list(panel=c(PanelOne=5), seltype="Equal", over=25),
                    "2.2"=list(panel=c(PanelOne=7), seltype="Equal", over=35),
                    "2.3"=list(panel=c(PanelOne=3), seltype="Equal", over=15),
                    "2.4"=list(panel=c(PanelOne=0), seltype="Equal", over=0),
                    "3.1"=list(panel=c(PanelOne=5), seltype="Equal", over=25),
                    "3.2"=list(panel=c(PanelOne=5), seltype="Equal", over=25),
                    "3.3"=list(panel=c(PanelOne=1), seltype="Equal", over=5),
                    "3.4"=list(panel=c(PanelOne=0), seltype="Equal", over=0),
                    "4.1"=list(panel=c(PanelOne=4), seltype="Equal", over=20),
                    "4.2"=list(panel=c(PanelOne=2), seltype="Equal", over=10),
                    "4.3"=list(panel=c(PanelOne=0), seltype="Equal", over=0),
                    "4.4"=list(panel=c(PanelOne=0), seltype="Equal", over=0))

att=na.omit(att)

#select the sample
SurveySites<-grts(design = stratdsgn,
          DesignID = "STRATIFIED",
          type.frame = "linear",
          src.frame = "shapefile",
          in.shape = "GRTS_Streams_1",
          att.frame = att,
          stratum = "REACH_TYPE_ID",
          shapefile = FALSE)

head(SurveySites@data)
summary(SurveySites)
plot(SurveySites)

# write out a new shapefile (including .prj component)
writeOGR(lin, ".", "GRTS_Streams_4Survey", driver="ESRI Shapefile")
```

APPENDIX C

Appendix C: R code for multivariate analysis of habitat data

```
#################### LDA #####################
attach(LDA_HabData)
detach(LDA_HabData)

install.packages("MASS")
library(MASS)
install.packages("ggplot2")
library(ggplot2)
install.packages("scales")
library(scales)
install.packages("gridExtra")
library(gridExtra)

ldamodel= lda(G~ $`Unit Length`, NewData$`Unit Width`, NewData$`Unit Area`,
NewData$`Unit Mean Depth`, NewData$`Cover (%Shelter)`, NewData$`%Pools`,
data=LDA_HabData)
ldamodel
par(mfrow=c(1,1))
plot(ldamodel)


################ plotting the model #################
#select the colors that will be used
library(RColorBrewer)
#all palette available from RColorBrewer
display.brewer.all()
#we will select the first 8 colors in the Set1 palette
cols<-brewer.pal(n=8,name="Set1")
#cols contain the names of 8 different colors
#create a color vector corresponding to levels in the T1 variable in dat
cols_t1<-cols[LDA_HabData$G]
#plot
plot(ldamodel, data=LDA_HabData,col=cols_t1, pch=16)

######### a measure of model accuracy ##############
prop.lda = ldamodel$svd^2/sum(ldamodel$svd^2)
prop.lda
```

```
ldapred= predict(ldamodel, LDA_HabData)
ldapred

ldaclass= ldapred$class
ldaclass

##Determine how well model1 fits
ldatable= table(ldaclass, LDA_HabData$G)
ldatable

accuracy= sum(diag(ldatable))/sum(ldatable)*100
accuracy


#################### MANOVA ########################
hab.manova1= manova(cbind(NewData$`Unit Length`, NewData$`Unit Width`,
NewData$`Unit Area`, NewData$`Unit Mean Depth`, NewData$`Cover (%Shelter)`,
NewData$`%Pools`)~ NewData$`Reach Type ID`, data = NewData)
summary(hab.manova1)

summary.aov(hab.manova1)

plot(hab.manova1)
```

APPENDIX D

Appendix D: Formulas, definitions, and values of parameters of the UCM model (Cramer and Ackerman, 2009).

UNIT SCALE
PARAMETERS

den (fish/m2)

Unit Name	Unit ID	Steelhead Parr Density	SD	Chinook Parr Density	SD
Backwaters	6	0.05	0.02	0.13	0.05
Cascades	2	0.03	0.02	0.024	0.01
Flatwater	3	0.08	0.04	0.07	0.02
Pools	4, 5	0.17	0.20	0.24	0.10
Riffles	1	0.03	0.02	0.024	0.01

chnl

Glides	If W > 24: (W - 24)*.35/W + 24/W
Pools	if W > 24: (W - 24)*.75/W + 24/W if L > 4*W: L = 4*W
Riffles	if W > 24: (W-24)*.15/W + 24/W

where W = wetted width of unit in meters

dep

Pools & Glides	If D is < 0.10: 0.0*D If D is 0.10 - 0.80: (0.30* D - 0.027)/0.17 if D is >0.8: 0.22/0.17
Riffles	If D is < 0.1: 0.0 * D If D is 0.10 - 0.16: (0.5*D - 0.5)/0.03 If D is 0.16 - 0.30: (0.29*D - 0.017)/0.03 If D is 0.30 - 0.80: (0.25*D - 0.003)/0.03 If D is 0.80 - 0.90: 0.20/0.03

If D is 0.90 - 1.50: (-0.32*D + 0.485)/0.03
If D is >1.50: 0

where D = depth in meters

cvr

Pools & Glides

If wood complexity = 1: 0.58
If wood complexity = 2: 1.00
If wood complexity = 3: 1.42
if wood complexity = 4 or 5: 1.84

Riffles

If Bpr < 0.25: 1.0
If Bpr is 0.25 - 0.75: 1 + 12*(Bpr = 0.25)
If Bpr is > 0.75: 7.0

where Bpr = proportion of substrate in riffles comprised of boulders

REACH SCALE PARAMETERS: multiply by unit-scale capacity adjustment
prod = (turb*drift*fines*alk)

turb

if Dr is < 0.3m: 10^(2-(1+0.024*N)*0.1)/10^2-0.1
If Dr is 0.3-0.5m: 10^(2-(1+0.024*N)*0.3))/10^2-0.3
If Dr is > 0.5m: 10^(2-(1+0.024*N)*0.5))/10^2-0.5

where Dr = mean depth of riffles within the reach
whre N = NTU

drift

If Rp > 0.5: 1.0
If Rp is ≤ 0.5: 0.1+1.8*Rp
where Rp = proportion of reach surface area that is riffle or cascade

fines

If Fp is <0.1: 1.0

REACH SCALE PARAMETERS: multiply by unit-scale capacity adjustment

If Fp is ≥0.1: 1.11 - 1.1*Fp

where Fp = proportion of substrate in riffles that is comprised of fines

alk

(mgCaCO3/l)^0.45/4.48

winter

If Cp < 0.15: 0.20 + (Cp)/0.15*0.8

If Cp > 0.15: 1.0

where Cp = Proportion of substrate in the stream comprised of cobbles

temp

Tsi = 1/(1+e^-a-bTi)

where

Tsi = Temp scalar for capacity for reach i in a given week

a = intercept of logit(Tsi) = 19.63

b = slope of logit(Tsi) = -0.98

T = weekly average temperature (WAT) for reach i in a given week

APPENDIX E

Appendix E: R code for UCM parr capacity baseline model

```
########################################################################
########################################################################
#############################Unit Scale Capacity#########################
#################Area * Density * Channel * Depth * Cover####################
########################################################################
########################################################################


################################################################
######################Standardized Density#############
################################################################

Den = function(Area_use, Unit.Name)
  {
   print(Area_use)
    if(Unit.Name =="Riffle") value= (Area_use*0.03)
    else if(Unit.Name == "Cascade") value= (Area_use*0.03)
    else if(Unit.Name == "Pool") value= (Area_use*0.17)
    else if(Unit.Name == "Flatwater") value= (Area_use*0.08)
    else value=0

    return(value)
  }

TestDen = Den(100, "Pool")
print(TestDen)


################################################################
#######################Usable Channel Parameter#################
################################################################

ChnlFlat= function(Width, Unit.Name)
{
  if(Unit.Name == "Flatwater")
  {
    if(Width >24) value=((Width - 24)*0.35/Width + 24/Width)
```

```
  }
  return(value)
}

Test01= ChnlFlat(28, "Flatwater")
print(Test01)


ChnlPool= function(Width, Unit.Name)
{
  if(Unit.Name == "Pool")
  {
    if(Width > 24) value=((Width - 24)*0.75/Width + 24/Width)

    else if(Length > 4*Width) value= 4*Width
  }
  return(value)
}

Test02= ChnlPool(28, "Pool")
print(Test02)


ChnlRif= function(Width, Unit.Name)
{
  if(Unit.Name == "Riffle")
  {
    if(Width > 24) value = ((Width-24)*0.15/Width + 24/Width)
  }
  return(value)
}

Test03= ChnlRif(28, "Riffle")
print(Test03)



###############################################################
#########################Depth Parameter########################
##############################################################

######################Depth Pools########################
```

```
DepPool = function(MaxDep_m, Unit.Name)
{
 if(Unit.Name == "Pool")
 {
  if(MaxDep_m <0.1) value=0*MaxDep_m

  else if(MaxDep_m <0.8) value= (0.3*MaxDep_m - 0.027)/.17

  else value= (0.22/.17)
 }
 else
 {
  print(paste("DepPoolunknown unit name", Unit.Name))
 }
 return(value)
}

Test04= DepPool(.9, "Pool")

print(Test04)


#######################Depth Flatwater#######################

DepFlat = function(Dep_m, Unit.Name)
{
 if(Unit.Name == "Flatwater")
 {
  if(Dep_m <0.1) value=0*Dep_m

  else if(Dep_m <0.8) value= (0.3*Dep_m - 0.027)/.17

  else value= (0.22/.17)  #when >=0.8
 }
 return(value)
}

Test05= DepFlat(0.32, "Flatwater")
print(Test05)


######################Depth Riffles###########################
DepRif = function(Dep_m, Unit.Name)
```

```
{
  if((Unit.Name == "Riffle")|(Unit.Name == "Cascade"))
  {
    if(Dep_m < 0.1) value=0*Dep_m

    else if(Dep_m <0.16) value= ((0.5*Dep_m - 0.05)/0.03)

    else if(Dep_m <0.3) value= ((0.29*Dep_m - 0.017)/0.03)

    else if(Dep_m <0.8) value= ((0.25*Dep_m - 0.003)/0.03)

    else if(Dep_m <0.9) value= (0.2/0.03)

    else if(Dep_m <1.5) value= ((-0.32*Dep_m +0.485)/0.03)

    else value= 0   ##when >=1.5
  }
  return(value)
}

Test06= DepRif(0.23, "Riffle")
print(Test06)


############################################################
########################Cover Parameter#######################
############################################################


###########################Shelter Rating for Pools &
Glides###########################

CvrPoolFlat = function(ShelterVal, Unit.Name)
{
  if((Unit.Name == "Pool")|(Unit.Name == "Flatwater")|(Unit.Name == "Dry"))
  {
    if(ShelterVal== 0) value=0

    else if(ShelterVal < 2) value= 0.58

    else if(ShelterVal < 3) value= 1.00

    else if(ShelterVal < 4) value= 1.42
```

```
    else value= 1.84 #when >=4

  }
  return(value)
}

Test07= CvrPoolFlat(0, "Dry")

print(Test07)


######################Proportion Boulders in Riffles########################

CvrRiffle = function(X.boulders, Unit.Name)
{
  if((Unit.Name =="Riffle")|(Unit.Name == "Cascade"))
    {
      if(X.boulders < 0.25) value=1.0

      else if(X.boulders<0.75) value=(1+12*(X.boulders- 0.25))

      else value= 7.0      ###when >=0.75
    }
    return(value)
}

Test08= CvrRiffle(.5, "Cascade")
print(Test08)


########################################################################
############################# While loop ###############################
########### For running above functions with each habitat unit in dataset ###########
########################################################################

numrows=nrow(S235_Analysis_1)
#numrows=1
print(numrows)
  i=0
SumDensity=0
while(i<numrows)
{
```

```
  print("#####")
  row=S235_Analysis_1[i+1, ]                ############ row is actually collumn "i"
starting at 1

  ###Density * Area_use for each habitat unit
  Area_use=row[7]
  Unit.Name=row[2]
  Density=Den(Area_use, Unit.Name)              ############## setting Density = Den
function from above
  print(Unit.Name)
  print(paste("Density=",Density))


  ## Depth Scalar for each habitat unit
  if (Unit.Name=="Riffle")
  {
    Dep_m=row[8]
    Unit.Name=row[2]
    MeanDepthDensity=DepRif(Dep_m, Unit.Name)    ############ setting
MeanDepthDensity equal to DepRif function from above
    print(Unit.Name)
    print(paste("DepthScalar=",MeanDepthDensity))

    Density=Density*MeanDepthDensity
  }
  else  if (Unit.Name=="Pool")
  {
    print("Calling DepPool")
    MaxDep_m=row[9]
    Unit.Name=row[2]
    print(Unit.Name)
    MaxDep_mDensity=DepPool(MaxDep_m, Unit.Name)         ########### setting
MaxDep_mDensity equal to DepPool function from above
    print(paste("DepthScalar=",MaxDep_mDensity))

    Density=Density*MaxDep_mDensity

  }
  else if (Unit.Name=="Flatwater")
  {
    print("Calling DepFlat")
    Dep_m=row[8]
    Unit.Name=row[2]
```

```
    print(Unit.Name)
    MeanDepthFlatDensity= DepFlat(Dep_m, Unit.Name)
    print(paste("DepthScalar=",MeanDepthFlatDensity))

    Density=Density*MeanDepthFlatDensity
  }

  if((Unit.Name == "Pool")|(Unit.Name == "Flatwater")|(Unit.Name == "Dry"))
  {
    print("Calling ShelterVal")
    ShelterVal=row[16]
    Unit.Name=row[2]
    print(Unit.Name)
    ShelterScalar=CvrPoolFlat(ShelterVal, Unit.Name)
    print(paste("ShelterScalar=",ShelterScalar))


    Density=Density*ShelterScalar

  }
  else
  {
    print("Calling CvrRiffle")
    X.boulders=row[24]
    Unit.Name=row[2]
    print(Unit.Name)
    na.omit(X.boulders)
    CvrRiffleScalar=CvrRiffle(X.boulders, Unit.Name)
    print(paste("BoulderScalar=",CvrRiffleScalar))

    Density=Density*CvrRiffleScalar

  }
print(Density)
SumDensity= Density+SumDensity

  i=i+1
}
print(SumDensity)
TotalArea_use= sum(S235_Analysis_1$Area_use)
print(TotalArea_use)
SumDensity/TotalArea_use
```

APPENDIX F

Appendix F: R code for GAM analysis of predicted densities in response to IP scores

```
attach(DensityStreams_4IPAnalysis)
install.packages("mgcv")
library(mgcv)

#### Plot the data
plot(Chinook SalmonData$CH_DEN~log(Chinook SalmonData$CHK_IP_CUR),
xlab="Chinook Salmon IP Score", ylab="Chinook Salmon Parr Stratified Mean Density")
plot(ST_DEN~ST_IP_CURV, data = DensityStreams_4IPAnalysis, xlab="Steelhead
trout IP Score", ylab="Steelhead trout Parr Stratified Mean Density")

#### Chinook Salmon parr density - IP relationship GAM
GAM.Chinook Salmon= gam(CH_DEN~s(CHK_IP_CUR), data = Chinook SalmonData,
gamma = 100)
plot(GAM.Chinook Salmon, xlab="Chinook Salmon IP Score", ylab="Chinook Salmon
Parr Stratified Mean Density")
summary(GAM.Chinook Salmon)
AIC(GAM.Chinook Salmon)

#### Steelhead trout parr density – IP relationship GAM
GAM.Steelhead trout=gam(ST_DEN~s(ST_IP_CURV), data =
DensityStreams_4IPAnalysis, gamma = 40)
plot(GAM.Steelhead trout, xlab="Steelhead trout IP Score", ylab="Steelhead trout Parr
Stratified Mean Density")
summary(GAM.Steelhead trout)
AIC(GAM.Steelhead trout)
```

APPENDIX G

Appendix G: Habitat Survey Data

Reach Type ID	Reach Type	Site Name	Stream Name	Unit #	Unit Type	Unit Name	Unit Length	Unit Width	Unit Area	Unit Mean Depth	Unit Max Depth	Cover (%Shelter)	Cover (%Boulders/BR)	Canopy Cover	Pool Temp	Air Temp	% Fines	Survey Reach Area	Ph	Turbidity	CFS	Survey Time
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	1	5	Pool	17	1.5	25.5	0.18	0.27	80	0	95	22	35	0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	2	1	Riffle	1	0.5	0.5	0.12	0.13	10		10			0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	3	4	Pool	8.7	2.47	21.489	0.14	0.25	60	0	95			0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	4	4	Pool	13	2.73	35.49	0.28	0.44	30		50			0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	5	1	Riffle	22	2.8	61.6	0.10	0.15	10					0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	6	5	Pool	10.5	2	21	0.25	0.46	70		70			0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	7	3	Flatwater	21.5	2.2	47.3	0.18	0.30	30	0				0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	8	4	Pool	11.5	2.7	31.05	0.31	0.48	20	0	20			0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	9	1	Riffle	11	0.8	8.8	0.06	0.08	5					0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	9.1	1	Riffle	15	0.8	12	0.06	0.08	30			23	35	0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	10	6	Pool	7	5.85	40.95	0.28	0.43	75	0	80			0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	11	3	Flatwater	26	3.17	82.42	0.15	0.24	15	0	20			0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	12	4	Pool	9.8	2.9	28.42	0.19	0.30	45	0	10	20.5		0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	13	3	Flatwater	5.5	1.85	10.175	0.13	0.18	10					0.33	438	6.5	0.7	0.15	2.75
1.2	0-2%, 2-10km2	S029	Packsaddle Cr	14	5	Pool	7	1.65	11.55	0.26	0.41	70	0	30	20	30	0.33	438	6.5	0.7	0.15	2.75
1.3	0-2%, 10-100km2	S021	Bear Cr	1	1	Riffle	27.9	3.97	110.763	0.23	0.32	10	0	40		16	0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	1.1	6	Pool	12.2	2.36	28.792	0.23	0.42	35	5	80			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	1.2	1	Riffle	14.4	2.53	36.432	0.09	0.12	20					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	2	3	Flatwater	21.8	5.64	122.952	0.32	0.78	5	0	50			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	3	1	Riffle	40	3.63	145.2	0.23	0.29	15					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	4	4	Pool	14	4.24	59.36	0.49	0.76	65	0	75			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	5	3	Flatwater	19	3.1	58.9	0.31	0.39	10					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	6	1	Riffle	9.75	4.04	39.39	0.20	0.29	20					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	7	5	Pool	20	4.6	92	0.30	0.55	55	0	40			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	8	1	Riffle	10.6	3.8	40.28	0.30	0.47	15					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	9	5	Pool	15.2	5.39	81.928	0.34	0.48	35	0			20	0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	10	1	Riffle	20.8	5	104	0.21	0.26	15	5				0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	11	5	Pool	14.5	4.6	66.7	0.34	0.44	45					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	12	1	Riffle	8.2	4.1	33.62	0.17	0.26	20					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	13	4	Pool	8.53	5.5	46.915	0.66	1.04	35	0	80			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	14	3	Flatwater	25	4.12	103	0.43	0.83	25	0	90			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	15	5	Pool	6.4	2.2	14.08	0.52	0.79	30					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	16	1	Riffle	15.6	4.1	63.96	0.15	0.19	10					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	17	4	Pool	25.3	5.4	136.62	0.40	0.61	10					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	18	1	Riffle	19.5	4	78	0.23	0.34	10					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	19	5	Pool	13.5	4.3	58.05	0.62	1.13	20	5	90		21	0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	20	3	Flatwater	66	3.9	257.4	0.27	0.42	35	0	75			0.22	4253	6.5	0.25	9.94	9.5

1.3	0-2%, 10-100km2	S021	Bear Cr	21	1	Riffle	35.5	5.8	205.9	0.16	0.24	15	2	60			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	22	3	Flatwater	37	5.3	196.1	0.16	0.21	50					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	23	4	Pool	9.3	3.13	29.109	0.35	0.44	30	0	70			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	24	1	Riffle	11	4.1	45.1	0.50	0.57	30					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	25	5	Pool	8.1	3.8	30.78	0.64	0.85	40					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	26	1	Riffle	29	4.1	118.9	0.26	0.29	40					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	27	5	Pool	12	4	48	0.45	0.75	50					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	28	3	Flatwater	20	3.08	61.6	0.42	0.61	70				22	0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	29	1	Riffle	38.5	3.57	137.445	0.28	0.32	61	5	90			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	30	3	Flatwater	94	6.18	580.92	0.16	0.25	25	0	80			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	31	1	Riffle	18	5.6	100.8	0.16	0.20	50					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	32	3	Flatwater	35.8	6.28	224.824	0.14	0.22	30					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	33	5	Pool	18	4.71	84.78	0.49	0.76	50	0	90			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	34	1	Riffle	11.7	4.71	55.107	0.01	0.21	30	0				0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	35	3	Flatwater	42	4.05	170.1	0.26	0.40	30					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	36	5	Pool	16.5	3.7	61.05	0.36	0.53	50		85			0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	37	3	Flatwater	50	4.6	230	0.27	0.33	30					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S021	Bear Cr	38	1	Riffle	20	4.69	93.8	0.14	0.17	10					0.22	4253	6.5	0.25	9.94	9.5
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	1	1	Riffle	46.2	4.3	198.66	0.15	0.24	25	20	5		18.5	0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	2	3	Flatwater	11.5	3.2	36.8	0.28	0.40	15	15	0			0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	3	1	Riffle	21.6	4.3	92.88	0.15	0.24	30					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	4	5	Pool	11.1	3.1	34.41	0.31	0.54	45	10	10	19.5		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	5	1	Riffle	6	4.3	25.8	0.15	0.24	30					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	6	5	Pool	9.1	2	18.2	0.22	0.34	50	5	25	19.5		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	7	1	Riffle	4	4.3	17.2	0.15	0.24	30					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	8	5	Pool	26	6.5	169	0.65	1.40	55	35	2	19		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	9	7	Dry	49.5		0	0.00	0.00	0					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	10	1	Riffle	19.4	4.3	83.42	0.15	0.24	30					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	11	3	Flatwater	20.6	2.7	55.62	0.19	0.29	65	0	30		31.5	0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	12	1	Riffle	15.5	4.8	74.4	0.14	0.25	10	8	5			0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	13	4	Pool	28.5	5.1	145.35	0.49	0.64	40	0	10	20		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	14	1	Riffle	69	4.8	331.2	0.14	0.25	10					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	15	5	Pool	23.5	5.6	131.6	0.25	0.52	65	5	5	20		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	16	1	Riffle	20.1	4.8	96.48	0.14	0.25	10					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	17	7	Dry	4.6		0	0.00	0.00	0					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	18	5	Pool	30.3	4.8	145.44	0.36	0.55	50	5	5	20.5		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	19	1	Riffle	3.5	4.8	16.8	0.14	0.25	10					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	20	5	Pool	8.6	3.7	31.82	0.41	0.62	95	35	40	20		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	21	5	Pool	12.6	3	37.8	0.35	0.61	50	45	0	21	31.5	0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	22	7	Dry	5.2		0	0.00	0.00	0					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	23	3	Flatwater	4.5	1	4.5	0.19	0.29	5	0				0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	24	1	Riffle	12.3	1.5	18.45	0.08	0.13	75	0	40			0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	25	5	Pool	17.8	2.6	46.28	0.26	0.47	55	20	10	20		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	26	3	Flatwater	14.5	1	14.5	0.19	0.29	10					0.38	2770	7.4	0.2	0.06	4.6

1.3	0-2%, 10-100km2	S016	Smokehouse Cr	27	7	Dry	55.1		0	0.00	0.00	0					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	28	4	Pool	19.5	4.9	95.55	0.50	0.85	15	10	5	21.5		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	29	1	Riffle	9.5	1.5	14.25	0.08	0.13	70					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	30	7	Dry	107.2		171.52	0.00	0.00	0	0				0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	30.1	5	Pool	9.7	1.6	11.64	0.17	0.24	55	5	80	21.5	33	0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	31	1	Riffle	15	1.2	78	0.07	0.10	25	0	75			0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	32	3	Flatwater	18.3	5.2	82.35	0.15	0.31	20	5	35	0.3		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	33	4	Pool	17.4	4.5	31.32	0.27	0.47	15	5	7	24		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	34	1	Riffle	10.6	1.8	59.36	0.11	0.15	10		0			0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	35	4	Pool	43	5.6	51.6	0.30	0.46	45	15	30	23		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	36	1	Riffle	39.2	1.2	168.56	0.07	0.10	10					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	37	4	Pool	20.3	4.3	36.54	0.38	0.73	15	5	60	21		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	38	1	Riffle	25.8	1.8	85.14	0.07	0.10	10					0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S016	Smokehouse Cr	39	5	Pool	17.5	3.3	57.75	0.20	0.30	45	20	15	20		0.38	2770	7.4	0.2	0.06	4.6
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	1	3	Flatwater	12.7	2.2	27.94	0.15	0.30	35	15	25		14.1	0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	2	1	Riffle	6.7	2.2	14.74	0.08	0.21	35	25	15			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	3	5	Pool	10	2.5	25	0.30	0.82	55	20	5	16		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	4	1	Riffle	20.7	2.2	45.54	0.08	0.21	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	5	4	Pool	27	3.8	102.6	0.34	0.61	67	25	50	15		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	6	3	Flatwater	25.5	2.2	56.1	0.15	0.30	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	7	1	Riffle	13.5	2.2	29.7	0.08	0.21	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	8	5	Pool	14.7	3	44.1	0.41	0.91	87	35	5	15		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	9	1	Riffle	15.5	2.2	34.1	0.08	0.21	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	10	5	Pool	11.4	2.8	31.92	0.17	0.34	45	20	10	16		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	11	1	Riffle	56	2.5	140	0.14	0.21	45	25	40		20	0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	12	5	Pool	10.2	3.5	35.7	0.24	0.46	35	25	90	16		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	13	3	Flatwater	15.5	3.8	58.9	0.08	0.21	15	5	10			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	14	5	Pool	18	3	54	0.05	0.73	75	20	60	15		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	15	1	Riffle	27.5	2.5	68.75	0.14	0.21	50					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	16	3	Flatwater	55	3.8	209	0.08	0.21	10					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	17	4	Pool	13.5	2.1	28.35	0.34	0.49	75	23	30	18		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	18	1	Riffle	7	22.5	157.5	0.14	0.21	50					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	19	3	Flatwater	27	2.8	75.6	0.08	0.21	10					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	20	5	Pool	8.5	2.4	20.4	0.15	0.27	55	20	90	19		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	21	1	Riffle	35	2.5	87.5	0.09	0.12	35	20	40		23	0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	21.1	5	Pool	6	1.8	10.8	0.14	0.43	35	10	10	19		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	21.2	6	Pool	4	2	8	0.20	0.46	40	10	5	19.5		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	21.3	1	Riffle	12.3	0.5	6.15	0.10	0.13	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	22	3	Flatwater	8.9	1	8.9	0.12	0.15	5	5	5			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	23	5	Pool	2	2	4	0.12	0.34	10	0	5	19		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	24	1	Riffle	5	2.5	12.5	0.09	0.12	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	25	3	Flatwater	14.2	1	14.2	0.12	0.15	10	0				0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	26	5	Pool	13.2	4.7	62.04	0.61	0.73	65	20	90	18.5		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	27	1	Riffle	6.2	2.5	15.5	0.09	0.12	30					0.33	2608	7.5	0.29	0.24	6.5

1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	28	4	Pool	9.5	2.5	23.75	0.29	0.40	45	5	50	20	28	0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	29	1	Riffle	5	1	5	0.05	0.06	0		0			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	30	5	Pool	11	3.2	35.2	0.21	0.43	95	10	60	20		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	31	3	Flatwater	8	2	16	0.11	0.12	70	0	40			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	32	5	Pool	14	2.8	39.2	0.20	0.34	95	5	30	18		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	32.1	3	Flatwater	11	2	22	0.11	0.12	70					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	33	5	Pool	15.9	3.8	60.42	0.27	0.40	45	10	40	20		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	34	1	Riffle	57.5	2	115	0.05	0.06	10					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	35	4	Pool	11.7	4.5	52.65	0.32	0.61	45	15	30	20		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	36	3	Flatwater	48	2	96	0.11	0.12	70					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	37	1	Riffle	20	1.8	36	0.08	0.12	20	15	5		30	0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	38	4	Pool	17.5	3.6	63	0.18	0.26	15	10	20	20		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	39	3	Flatwater	14	4.7	65.8	0.17	0.30	35	25	95			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	40	1	Riffle	7.5	1.8	13.5	0.08	0.12	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	41	5	Pool	10	3.1	31	0.23	0.37	75	15	95	18		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	42	1	Riffle	15	1.8	27	0.08	0.12	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	43	7	Dry	6	6	36	0.00	0.00	0					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	44	4	Pool	31	5.3	164.3	0.27	0.85	80	5	40	20		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	45	1	Riffle	12	1.8	21.6	0.08	0.12	30					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	46	7	Dry	4	6	24	0.00	0.00	0					0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	47	1	Riffle	13.2	1.5	19.8	0.05	0.18	40	0	30		32	0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	48	4	Pool	24.8	3.35	83.08	0.24	0.49	65	0	35	20		0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	49	1	Riffle	12	1.2	14.4	0.08	0.15	5	0	50			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	50	3	Flatwater	13.5	3.6	48.6	0.14	0.23	20	0	5			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S018	Rice Fork at Salt Cr	51	1	Riffle	15	0.35	5.25	0.24	0.15	30		60			0.33	2608	7.5	0.29	0.24	6.5
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	1	1	Riffle	19.2	3.1	59.52	0.09	0.15	25	0	20		13.3	0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	2	5	Pool	30	2.5	75	0.26	0.37	85	0	80	15		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	3	1	Riffle	20	3.1	62	0.09	0.15	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	4	4	Pool	14.4	3.2	46.08	0.24	0.49	20	0	95	15		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	5	1	Riffle	6	3.1	18.6	0.09	0.15	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	6	5	Pool	9	2.8	25.2	0.20	0.61	20	0	90	15		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	7	5	Pool	14.5	2.1	30.45	0.26	0.58	40	0	85	15		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	8	1	Riffle	9.7	3.1	30.07	0.09	0.15	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	9	4	Pool	18	3.5	63	0.59	0.64	25	0	100	15		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	9.1	6	Pool	7	1.5	10.5	0.08	0.18	5	0	90	16		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	10	1	Riffle	7.5	2.9	21.75	0.29	0.52	22	0	80		21	0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	11	4	Pool	18	9	162	0.23	0.46	45	20	95	15.5		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	12	3	Flatwater	13.7	4.3	58.91	0.11	0.15	10	0	60			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	13	1	Riffle	22.8	2.9	66.12	0.29	0.52	20					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	14	4	Pool	46	4.3	197.8	0.30	0.82	85	35	90	16		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	15	1	Riffle	12	2.9	34.8	0.29	0.52	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	16	5	Pool	14.5	3.6	52.2	0.23	0.49	20	0	80	16		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	17	1	Riffle	5.6	2.9	16.24	0.29	0.52	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	18	4	Pool	16.6	4.2	69.72	0.38	0.98	55	35	50	16		0.22	3390	7.9	0.35	1.72	8.6

1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	19	1	Riffle	4.9	2.9	14.21	0.29	0.52	20					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	20	4	Pool	16.7	4.1	68.47	0.21	0.40	35	15	95	16	23	0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	21	1	Riffle	14	3.6	50.4	0.14	0.24	25	5	80			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	22	4	Pool	11.7	3	35.1	0.24	0.46	30	10	95	16		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	23	1	Riffle	7.3	3.6	26.28	0.14	0.24	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	24	5	Pool	6	2.2	13.2	0.26	0.43	20	5	15	16		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	25	1	Riffle	4.5	3.6	16.2	0.14	0.24	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	26	5	Pool	20.6	7	144.2	0.08	0.40	65	45	60	16		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	27	3	Flatwater	14	4.1	57.4	0.15	0.37	50	30	80			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	28	5	Pool	12	6	72	0.76	1.07	75	50	95			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	29	1	Riffle	4	3.6	14.4	0.14	0.24	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	30	5	Pool	7.1	3.1	22.01	0.34	0.52	85	60	95	17	28	0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	31	3	Flatwater	20.3	3.4	69.02	0.46	0.58	60	35	55			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	32	5	Pool	10.3	5.2	53.56	0.30	0.67	72	60	20	18		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	33	2	Cascade	11.7	3.2	37.44	0.21	0.30	75	40	75			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	34	3	Flatwater	8.4	3.4	28.56	0.46	0.58	50					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	35	1	Riffle	23.6	4.5	106.2	0.11	0.21	45	10	60			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	35.1	5	Pool	7	5	35	0.27	0.82	80	60	60	18		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	36	5	Pool	20	4	80	0.17	0.24	45	10	50	18.5		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	37	4	Pool	20	5.7	114	0.21	0.82	90	45	95	18.5		0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	38	1	Riffle	5	4.5	22.5	0.11	0.21	50					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	39	5	Pool	9	5.4	48.6	0.70	0.91	45	30	10		30	0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	40	5	Pool	10.5	5.3	55.65	0.21	0.55	65	50	16			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	41	5	Pool	17.5	3.8	66.5	0.35	0.91	50	20	35			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	42	1	Riffle	10.5	4	42	0.06	0.27	25	5	90			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	43	5	Pool	11.7	5.7	66.69	0.64	0.67	70	30	35			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	44	5	Pool	12.2	3	36.6	0.64	0.70	50	30	5			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	45	3	Flatwater	8.6	4.2	36.12	0.23	0.37	25	10	70			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	46	2	Cascade	15	4.4	66	0.27	0.64	80	60	5			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	47	4	Pool	15.9	3.8	60.42	0.26	0.55	60	20	90			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	48	3	Flatwater	33	4.2	138.6	0.23	0.37	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	49	1	Riffle	31	2.5	77.5	0.14	0.24	35	8	45		30	0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	49.1	6	Pool	4.5	1	4.5	0.27	0.52	50	0	45			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	50	4	Pool	40.5	4.8	194.4	0.29	0.70	40	15	10			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	51	1	Riffle	13.9	2.5	34.75	0.14	0.24	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	51.1	5	Pool	12.2	3.5	42.7	0.29	0.64	25	5	100			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	52	5	Pool	7.2	4	28.8	0.26	0.49	25	15	85			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	53	5	Pool	22	4	88	0.58	0.67	50	40	40			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	54	1	Riffle	5.5	2.5	13.75	0.14	0.24	30					0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	55	5	Pool	18	3.6	64.8	0.27	0.73	50	30	80			0.22	3390	7.9	0.35	1.72	8.6
1.3	0-2%, 10-100km2	S013	Rice Cr at mouth	56	3	Flatwater	14.5	3	43.5	0.15	0.21	10	5	90			0.22	3390	7.9	0.35	1.72	8.6
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	1	3	Flatwater	88.7	12.2	1082.14	0.40	0.44	15	3	10	16	22.8	0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	2	1	Riffle	43	12.8	550.4	0.28	0.38	26	10	10			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	3	3	Flatwater	103	11.4	1174.2	0.30	0.46	20	10	15			0.31	6271	6.5	0.57	11.33	5.5

1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	4	5	Pool	17	12.9	219.3	0.66	0.88	40	20	10			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	5	3	Flatwater	52	8.6	447.2	0.32	0.34	15	5	5			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	6	1	Riffle	21.5	13.8	296.7	0.47	0.67	55	15	60			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	7	3	Flatwater	29	9.3	269.7	0.22	0.37	25	0	10			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	8	5	Pool	35	10.2	357	0.46	0.67	60	5	20			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	9	4	Pool	37	10.2	377.4	0.62	0.98	35	5	15			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	10	3	Flatwater	23.5	5.4	126.9	0.34	0.43	40	5	70			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	11	1	Riffle	36.5	5.2	189.8	0.12	0.14	40	5	75	19	29.4	0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	11.1	6	Pool	6	2.5	15	0.08	0.08	65	0	75			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	12	3	Flatwater	86.2	9.4	810.28	0.23	0.26	45	5	35			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	13	1	Riffle	24	7	168	0.23	0.28	75	20	55			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	14	5	Pool	16	5.6	89.6	0.57	0.93	65	10	15			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S038	Mainstem at Horse Cr	15	3	Flatwater	19	5.1	96.9	0.34	0.42	30	15	70			0.31	6271	6.5	0.57	11.33	5.5
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	1	2	Cascade	26	7.1	184.6	0.40	0.59	55	45	5	16.5	12	0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	2	5	Pool	7.5	8.5	63.75	0.61	1.07	65	60	2	17		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	3	4	Pool	30	8.3	249	0.73	1.10	65	60	15	17.5		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	4	1	Riffle	11.3	3.3	37.29	0.40	0.64	60	50	3			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	5	5	Pool	11	6.1	67.1	0.55	0.88	40	35	2	18		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	6	3	Flatwater	20	8	160	0.37	0.50	20	15	2			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	7	4	Pool	22	9.9	217.8	0.47	0.84	25	15	10	18		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	8	5	Pool	15.5	8.5	131.75	0.68	1.25	80	55	25	18.5		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	9	3	Flatwater	12.5	5.35	66.875	0.29	0.43	50	5	20			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	10	1	Riffle	6.7	5.8	38.86	0.16	0.27	45	5	25			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	11	5	Pool	15.6	6.05	94.38	0.58	0.99	75	55	5	19.5	22	0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	12	1	Riffle	48	8.35	400.8	0.34	0.64	85	40	10			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	13	3	Flatwater	34.5	19	655.5	0.34	0.66	40	5	15			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	14	4	Pool	80	18	1440	1.30	2.83	60	15	25	18.5		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	15	1	Riffle	60	10.6	636	0.27	0.44	35	20	15			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	16	4	Pool	100	14	1400	0.98	1.45	60	30	25	20.5		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	17	3	Flatwater	53	6	318	0.45	0.64	55	45	10			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	18	2	Cascade	20.5	4.1	84.05	0.25	0.49	65	50	5			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	19	4	Pool	46	13	598	1.33	2.62	60	15	15	20.5		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	20	3	Flatwater	85	10.5	892.5	0.58	1.11	55	20	10			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	21	1	Riffle	37.4	6.3	235.62	0.46	0.61	70	50	7		29.1	0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	22	3	Flatwater	41	5.8	237.8	0.26	0.45	45	10	5			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	23	1	Riffle	47.5	6.4	304	0.39	0.65	70	45	5			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	24	5	Pool	14.2	10.4	147.68	0.39	0.64	40	30	15	24		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	25	5	Pool	18.6	11.5	213.9	0.66	0.93	35	25	10	24		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	26	5	Pool	23.9	7.8	186.42	0.32	0.56	75	40	25			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	27	1	Riffle	95.2	7.8	742.56	0.32	0.56	50	45	20			0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S037	Mainstem at Rattlesnake Cr	27.1	6	Pool	20	13	260	0.49	0.79	80	45	15	23		0.22	10064	8	0.24	3.8	8
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	1	3	Flatwater	22.3	6.8	151.64	0.45	0.64	75	60		20	29	0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	2	1	Riffle	4.5	9.8	44.1	0.34	0.64	75	25				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	3	5	Pool	13.5	10.5	141.75	0.58	0.99	80	25				0.50	5668	8.1		5.34	3

1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	4	1	Riffle	7.5	9.8	73.5	0.40	0.64	70	60				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	5	4	Pool	98	14	1372	0.73	1.10	55	40				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	5.1	6	Pool	20	5.5	110	0.52	0.64	40	30				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	6	1	Riffle	15	9.8	147	0.16	0.27	70	55				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	7	3	Flatwater	24.2	6.8	164.56	0.29	0.43	70	50				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	8	1	Riffle	22.5	9.8	220.5	0.46	0.64	75	20				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	9	4	Pool	145	14	2030	1.37	1.62	60	30				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	10	1	Riffle	7.8	7.8	60.84	0.37	0.55	60	35		25	36.5	0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	11	5	Pool	40	12.1	484	1.16	1.37	60	45				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	12	5	Pool	20.2	12.5	252.5	1.10	1.28	60	35				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S040	Mainstem at Copper Butte Cr	13	2	Cascade	49.5	8.4	415.8	0.55	0.70	75	60				0.50	5668	8.1		5.34	3
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	1	1	Riffle	22.4	3.55	79.52	0.15	0.25	30	0	70		21	0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	2	4	Pool	67	8.8	589.6	0.46	0.73	60	15	50	19.5		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	2.1	5	Pool	14.5	4.3	62.35	0.59	0.81	45	10	75	18		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	3	3	Flatwater	16	5.8	92.8	0.49	0.73	75	10	35	18.5		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	4	1	Riffle	24.5	6.7	164.15	0.19	0.27	60	10	25			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	5	4	Pool	72	7.8	561.6	0.56	1.07	75	15	25	19		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	6	1	Riffle	12	9	108	0.21	0.40	10	0	5			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	7	5	Pool	26	6.2	161.2	0.27	0.46	20	5	2	20		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	8	3	Flatwater	27.5	8.2	225.5	0.21	0.34	50	0	60			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	9	1	Riffle	15.5	7.5	116.25	0.15	0.18	65	5	30			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	10	3	Flatwater	34.5	8.3	286.35	0.16	0.37	55	5	25		30	0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	11	5	Pool	49.5	8.3	410.85	0.37	0.59	65	5	25	25		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	12	1	Riffle	9	5	45	0.09	0.12	85	0	85			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	13	4	Pool	70	7.8	546	0.50	0.76	60	5	25	25		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	14	1	Riffle	18.5	9.2	170.2	0.05	0.24	30	0	20			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	15	3	Flatwater	111	8.3	921.3	0.34	0.46	50	10	5			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	16	5	Pool	28	7.1	198.8	0.53	0.91	65	5	50	24		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	17	7	Pool	11		0	0.00	0.00	0	0	35			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	18	3	Flatwater	15.5	6.2	96.1	0.14	0.27	20	5	35			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	19	5	Pool	13	6.8	88.4	0.32	0.50	20	10	20	26		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	20	3	Flatwater	67	6	402	0.22	0.49	45	10	35		31	0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	20.1	5	Pool	10	5	50	0.39	0.55	35	20	0	24		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	21	5	Pool	37	9.9	366.3	0.51	0.79	55	20	10	25		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	22	3	Flatwater	31	7.7	238.7	0.30	0.46	35	10	2			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	23	1	Riffle	5	2.5	12.5	0.10	0.15	25	0	10			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	24	5	Pool	37	4.5	166.5	0.34	0.46	43	15	5	23		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	25	1	Riffle	8.7	1.5	13.05	0.21	0.46	0	0	0			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	26	5	Pool	30	10.6	318	1.04	1.74	90	45	10	22		0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	27	1	Riffle	20.7	6.3	130.41	0.30	0.49	45	35	50			0.22	6828	7.9	7.6	1.11	6.75
1.4	0-2%, >100km2	S035	Rice Fork at Rice Cr	28	5	Pool	25.5	8.1	206.55	0.41	0.70	50	25	55	22		0.22	6828	7.9	7.6	1.11	6.75
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	1	4	Pool	1.9	1.4	2.66	0.15	0.20	0	25	50		68	0.17	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	2	2	Cascade	10.7	3.3	35.31	0.16	0.19	55	15	60				1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	3	4	Pool	8.7	1.9	16.53	0.17	0.22	20	5	70			0.33	1438	7.1	0.31	0.622	8

2.2	2-7%, 2-10km2	S084	Blue Slides Cr	4	2	Cascade	8.3	1.8	14.94	0.16	0.18	0						1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	5	1	Riffle	25.5	2.1	53.55	0.17	0.28	30	10	60				1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	6	5	Pool	7.6	2.4	18.24	0.17	0.34	20	15	70			0.33	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	7	1	Riffle	21	2.7	56.7	0.16	0.34	30		0				1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	8	4	Pool	4.2	2.3	9.66	0.26	0.37	10	0				0.17	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	9	2	Cascade	18.9	3.9	73.71	0.13	0.23	75	15					1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	10	6	Pool	6.2	1.93	11.966	0.20	0.23	15	10	60			0.17	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	11	4	Pool	6	2.5	15	0.23	0.30	40	0	80		72	0.17	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	12	1	Riffle	60	3.27	196.2	0.16	0.29	35	10	60				1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	13	4	Pool	2.5	2.9	7.25	0.22	0.30	30					0.33	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	14	1	Riffle	22.9	2.1	48.09	0.14	0.23	30						1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	15	4	Pool	4.5	3	13.5	0.20	0.41	10					0.17	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	16	1	Riffle	12.5	2.4	30	0.13	0.18	30						1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	17	4	Pool	2.5	1.4	3.5	0.11	0.38	10					0.17	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	18	1	Riffle	45	2.3	103.5	0.22	0.29	60						1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	19	6	Pool	3.5	2.2	7.7	0.21	0.28	70	10	30				1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	20	1	Riffle	10	1.9	19	0.15	0.23	15	10					1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	21	5	Pool	7	3.4	23.8	0.36	0.47	40	0	40		75	0.17	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	22	1	Riffle	32	1.7	54.4	0.17	0.31	25	5	60				1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	23	5	Pool	4.5	3.2	14.4	0.17	0.30	35	10				0.33	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	24	6	Pool	6.7	3.5	23.45	0.23	0.54	45	0	90				1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	25	1	Riffle	33.5	2.6	87.1	0.17	0.34							1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	26	5	Pool	4	1.9	7.6	0.29	0.39						0.33	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	27	1	Riffle	52	3.1	161.2	0.26	0.52							1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	28	5	Pool	7.4	2.7	19.98	0.22	0.34						0.33	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	29	1	Riffle	83	3.6	298.8	0.18	0.29							1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S084	Blue Slides Cr	30	5	Pool	3.5	3	10.5	0.25	0.41						0.33	1438	7.1	0.31	0.622	8
2.2	2-7%, 2-10km2	S081	Deer Cr	1	2	Cascade	5.6	3.7	20.72	0.19	0.29	50	20	75		18.3	0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	2	1	Riffle	9.5	3.3	31.35	0.19	0.30	30	5	80			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	3	5	Pool	5	3.6	18	0.33	0.46	50	30	40	14.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	4	2	Cascade	6	3.7	22.2	0.19	0.29	60					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	5	5	Pool	5	1.8	9	0.31	0.43	40	0	85	14.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	6	1	Riffle	6	3.3	19.8	0.19	0.30	30					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	7	3	Flatwater	8.5	2.3	19.55	0.19	0.24	25	5	90			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	8	2	Cascade	6.2	3.7	22.94	0.19	0.29	40					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	8.1	1	Riffle	6.2	1.6	9.92	0.19	0.30	30					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	9	5	Pool	4.7	3.2	15.04	0.28	0.43	55	15	85	14.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	10	1	Riffle	9.4	3	28.2	0.10	0.18	5		70		21	0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	10.1	5	Pool	2.1	3	6.3	0.26	0.40	60		85	15		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	11	5	Pool	5	4.2	21	0.56	0.94	65	50	60	15		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	12	5	Pool	7.3	3	21.9	0.42	0.78	60	50	70	15.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	13	2	Cascade	16.8	2.9	48.72	0.28	0.46	50	25	75			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	14	3	Flatwater	14	2.6	36.4	0.29	0.46	20	10	70			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	15	2	Cascade	6.5	2.9	18.85	0.28	0.46	50					0.26	1333	7.2	1.01	1.33	5.5

2.2	2-7%, 2-10km2	S081	Deer Cr	16	5	Pool	10	2.1	21	0.66	1.05	90	80	70	15.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	17	1	Riffle	13.5	3	40.5	0.10	0.18	10					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	18	5	Pool	6.9	2.3	15.87	0.25	0.53	40	5	75	16		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	19	1	Riffle	6	1.3	7.8	0.15	0.21	20		60		26.7	0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	20	5	Pool	6	2.1	12.6	0.24	0.43	85	60	65	15.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	21	1	Riffle	6.6	1.3	8.58	0.15	0.21	10					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	22	6	Pool	5.3	1.7	9.01	0.20	0.27	75	5	75			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	22.1	3	Flatwater	6	1.5	9	0.18	0.22	30		90			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	23	1	Riffle	18.7	1.3	24.31	0.15	0.21	15					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	24	2	Cascade	11	3.3	36.3	0.21	0.32	65	15	75			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	25	5	Pool	5.3	4	21.2	0.48	0.82	60	45	60	15.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	26	3	Flatwater	48	1.5	72	0.18	0.22	30					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	27	5	Pool	6.8	3.5	23.8	0.44	0.76	70	50	70	16		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	28	2	Cascade	9.6	3.6	34.56	0.24	0.40	50	40	65		29.4	0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	29	3	Flatwater	10.6	3.6	38.16	0.16	0.25	10	5	80			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	30	5	Pool	5.9	4.3	25.37	0.31	0.60	30	10	90	16.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	31	1	Riffle	4	1.5	6	0.19	0.25	25		95			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	32	5	Pool	12.5	2.3	28.75	0.24	0.37	40	5	75	16.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	33	1	Riffle	3.9	1.5	5.85	0.19	0.25	30					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	34	5	Pool	7.4	3.5	25.9	0.30	0.51	20	0	90	16.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	35	1	Riffle	16.5	1.5	24.75	0.19	0.25	35					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	36	3	Flatwater	16.5	3.6	59.4	0.16	0.25	10					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	37	1	Riffle	17	1.5	25.5	0.19	0.25	10					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	38	5	Pool	8.4	3.9	32.76	0.44	0.89	55	40	70	16.5	32.2	0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	39	1	Riffle	12	2.3	27.6	0.21	0.32	20	5	80			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	40	3	Flatwater	14.8	2.4	35.52	0.18	0.26	30	5	80			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	41	1	Riffle	14.5	2.3	33.35	0.21	0.32	20					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	42	5	Pool	5.5	2.2	12.1	0.27	0.55	75	5	50	16.5		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	43	5	Pool	5.6	3.2	17.92	0.48	0.79	40	20	90	17		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	44	1	Riffle	4.8	2.3	11.04	0.21	0.32	10					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	45	5	Pool	5	4	20	0.26	0.49	65	25	90	17		0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	46	3	Flatwater	25	2.4	60	0.18	0.26	30					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	47	2	Cascade	3.2	2.6	8.32	0.14	0.18	50	30	80			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	48	4	Pool	7	3.3	23.1	0.34	0.58	45	5	60	17	35	0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	49	1	Riffle	7.5	2	15	0.12	0.18	25	5	30			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	50	3	Flatwater	23.7	3	71.1	0.31	0.46	45	5	70			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	51	2	Cascade	6.8	1	6.8	0.19	0.21	50	30	85			0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S081	Deer Cr	52	1	Riffle	6.3	2	12.6	0.12	0.18	30					0.26	1333	7.2	1.01	1.33	5.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	1	5	Pool	5.3	2.5	13.25	0.24	0.85	50	25	35	15.5	27	0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	2	1	Riffle	12	1.8	21.6	0.24	0.46	65	20	35			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	3	5	Pool	7	2.55	17.85	0.24	0.37	65	30				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	4	1	Riffle	10	1.8	18	0.24	0.46	70		45			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	5	5	Pool	5.2	2.1	10.92	0.38	0.46	60	25				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	6	1	Riffle	7.6	1.8	13.68	0.24	0.46	70		35			0.26	1397	8.1	0.33	2.46	6.5

2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	7	5	Pool	3.7	2.8	10.36	0.43	0.76	80	25				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	8	1	Riffle	8	1.8	14.4	0.24	0.46	70	0	45			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	9	3	Flatwater	6	3	18	0.18	0.24	55	45	70			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	10	5	Pool	5.7	2.4	13.68	0.38	0.61	75	15	20			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	11	2	Cascade	13	2.7	35.1	0.24	0.52	80	50	35	17.5	32	0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	12	3	Flatwater	6	2.1	12.6	0.23	0.38	15	5	75			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	13	5	Pool	4.5	3	13.5	0.38	0.55	60	40				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	14	2	Cascade	33	2.7	89.1	0.24	0.52	80		40			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	15	5	Pool	7.7	2.4	18.48	0.26	0.38	65	5	60			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	16	5	Pool	5	2.5	12.5	0.40	0.82	75	50				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	17	2	Cascade	13.5	2.7	36.45	0.24	0.52	80					0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	18	3	Flatwater	12.5	2.1	26.25	0.23	0.38	15					0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	19	2	Cascade	19	2.7	51.3	0.24	0.52	80		15			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	20	4	Pool	4.3	2.5	10.75	0.53	0.67	60	5	40			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	21	1	Riffle	8	2	16	0.24	0.49	35	5	65	18		0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	22	2	Cascade	8	3	24	0.23	0.29	80	50	30		32	0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	23	4	Pool	8	2.5	20	0.32	0.49	85	20				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	24	2	Cascade	6.7	3	20.1	0.23	0.29	80		50			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	25	5	Pool	4.1	2.6	10.66	0.34	0.54	65	20				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	26	1	Riffle	24	2	48	0.24	0.49	35		8			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	27	4	Pool	4.3	2.8	12.04	0.38	0.64	55	20				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	28	2	Cascade	5.6	3	16.8	0.23	0.29	80		55			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	29	5	Pool	4.6	2.7	12.42	0.69	0.91	65	30	60			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	30	1	Riffle	42	1.2	50.4	0.55	0.49	80		60			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	31	5	Pool	5.7	3	17.1	0.40	0.55	55	10	70	18.5		0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	32	3	Flatwater	20.7	3.2	66.24	0.21	0.43	85	15	85		32	0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	33	5	Pool	5.5	2.5	13.75	0.34	0.56	45	5	80			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	34	1	Riffle	48.8	3.2	156.16	0.17	0.27	80	20	60			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	35	2	Cascade	12	5	60	0.20	0.24	70	45	40			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	36	5	Pool	9	3.5	31.5	0.37	0.70	75	55				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	37	3	Flatwater	6.4	3.2	20.48	0.21	0.43	85					0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	38	2	Cascade	6.5	5	32.5	0.20	0.24	70					0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	39	3	Flatwater	8	3.2	25.6	0.21	0.43	85					0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	40	1	Riffle	20	3.2	64	0.17	0.27	50		45			0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	41	2	Cascade	29	3.5	101.5	0.18	0.34	90	50	65	18.5	30	0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	42	5	Pool	5.7	4.6	26.22	0.41	0.70	90	55				0.26	1397	8.1	0.33	2.46	6.5
2.2	2-7%, 2-10km2	S119	Thistle Glade Cr	43	2	Cascade	26.8	3.5	93.8	0.18	0.34	90					0.26	1397	8.1	0.33	2.46	6.5
2.3	2-7%, 10-100km2	S134	Cold Cr	1	1	Riffle	38.4	4	153.6	0.17	0.24	55	35	8		13.8		4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	2	5	Pool	5.6	3.2	17.92	0.31	0.44	4	25	9	13		0.33	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	3	2	Cascade	32.9	4.2	138.18	0.21	0.38	85	5	8				4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	3.1	5	Pool	5.3	2.4	12.72	0.32	0.47	5	25	9	13		0.33	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	3.2	5	Pool	3	5	15	0.30	0.44	8	4	7	13		0.33	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	4	4	Pool	25	5.3	132.5	0.71	1.67	85	4	5	13.5		0.33	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	5	2	Cascade	11.7	4.2	49.14	0.21	0.38	85						4001	7.6	0.37	1.54	6.75

2.3	2-7%, 10-100km2	S134	Cold Cr	6	1	Riffle	38	4	152	0.17	0.24	5						4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	7	5	Pool	15.4	5.7	87.78	0.39	0.59	35	2	85	13.5		0.50	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	8	1	Riffle	24.5	4	98	0.17	0.24	5	2					4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	9	2	Cascade	5.5	4.6	232.3	0.27	0.53	75	4	8		17.4		4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	9.1	5	Pool	7	3.5	24.5	0.45	0.62	75	65	85	13.5		0.17	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	1	3	Flatwater	16	4.7	75.2	0.48	0.91	4	25	75				4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	11	5	Pool	7	2.5	17.5	0.30	0.53	45	3	9	13.5		0.33	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	12	2	Cascade	13.7	4.6	63.2	0.27	0.53	75						4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	13	5	Pool	15	7.8	117	0.37	0.56	75	5	85			0.33	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	14	1	Riffle	2	1.5	3	0.12	0.17	15	1	9				4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	15	5	Pool	25.8	6.8	175.44	0.69	1.82	7	25	85	14		0.17	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	16	2	Cascade	64.5	4.6	296.7	0.27	0.53	75						4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	17	4	Pool	17.3	6.6	114.18	0.43	0.69	6	4	25	14.5		0.33	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	18	2	Cascade	21.8	4.8	14.64	0.23	0.34	3	25	75		23		4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	19	4	Pool	15	5.5	82.5	0.48	0.71	4	2	75	14.5		0.50	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	2	2	Cascade	36	4.8	172.8	0.23	0.34	3						4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	21	5	Pool	9	3.2	28.8	0.36	0.65	55	55	3	15		0.50	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	22	4	Pool	3	6.5	195	0.54	0.93	65	3	8	14.5		0.17	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	23	3	Flatwater	88.5	2.9	256.65	0.34	0.55	75	45	7				4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	23.1	6	Pool	5.1	4.1	2.91	0.32	0.41	6	5	9	14.5		0.17	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	24	4	Pool	21	5.3	111.3	1.00	1.52	8	15	6	15.5		0.33	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	25	2	Cascade	22.7	4.8	18.96	0.23	0.34	3						4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	26	4	Pool	28	5.8	162.4	0.42	0.85	65	25	7	15		0.17	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	27	2	Cascade	17	2.8	47.6	0.36	0.49	6	55	85		25		4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	28	3	Flatwater	3	4.4	132	0.42	0.66	6	15	75				4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	29	2	Cascade	18.8	14.8	278.24	0.43	0.69	7	5	65				4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	3	1	Riffle	15	4	6	0.24	0.35	25	2	6				4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S134	Cold Cr	31	4	Pool	2	13.2	264	1.25	2.44	75	25	4	15.5		0.50	4001	7.6	0.37	1.54	6.75
2.3	2-7%, 10-100km2	S021	Bear Cr	1	4	Pool	11.5	3.1	35.65	0.41	0.58	25	1	5	13	18	0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	2	4	Pool	8.5	4.9	41.65	0.48	0.55	35			13		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	3	3	Flatwater	8.5	3	25.5	0.34	0.46	55	3	75			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	4	1	Riffle	16.2	2.8	45.36	0.21	0.29	61	3	85			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	5	5	Pool	8	2.8	22.4	0.44	0.73	6	55	75	13		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	6	3	Flatwater	11	3	33	0.34	0.46	55					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	7	1	Riffle	3.5	2.8	9.8	0.21	0.29	5					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	8	5	Pool	8	3.8	3.4	0.42	0.71	6		9	13		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	9	2	Cascade	22	2.8	61.6	0.33	0.53	55	25	9			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	10	1	Riffle	14	2.8	39.2	0.34	0.29	4					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	11	5	Pool	1	3.8	38	0.35	0.52	65	5	7	13	18	0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	12	2	Cascade	8.8	3	26.4	0.27	0.41	45	3	85			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	13	3	Flatwater	9.5	4.1	38.95	0.25	0.36	2	15	85			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	14	4	Pool	8.5	3.9	33.15	0.41	0.76	35	25	9	13		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	15	2	Cascade	6	3	18	0.27	0.41	2					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	16	5	Pool	9.5	4.3	4.85	0.45	0.87	6		8	13		0.26	3080	7	0.49	4.01	8.75

2.3	2-7%, 10-100km2	S021	Bear Cr	17	2	Cascade	28	3	84	0.27	0.41	45					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	18	5	Pool	5.3	3.8	2.14	0.43	0.58	5	3	7	14		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	19	5	Pool	7	4.5	31.5	0.57	0.70	55		75	14		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	20	3	Flatwater	15.5	4.1	63.55	0.25	0.36	2					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	21	5	Pool	11.7	5.3	62.1	0.37	0.69	55	4	8	14	24	0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	22	2	Cascade	68	5.6	38.8	0.59	0.79	65	4	75			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	23	5	Pool	9.5	3.5	33.25	0.45	0.55	4	25	8	14.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	24	2	Cascade	1.4	5.6	58.24	0.59	0.79	65					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	25	1	Riffle	26	4.1	16.6	0.28	0.43	25	15	3			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	26	5	Pool	3.5	6.2	21.7	0.33	0.53	3	2	4	14.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	27	1	Riffle	14.5	4.1	59.45	0.28	0.43	25		7			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	28	4	Pool	5.3	3	15.9	0.27	0.49	3	2		14.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	29	1	Riffle	28	4.1	114.8	0.28	0.43	25					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	29.1	6	Pool	3.5	1.75	6.125	0.21	0.27	25					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	29.2	6	Pool	3	1	3	0.21	0.21	25				29	0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	30	4	Pool	8	4.6	36.8	0.36	0.58	45	25	55	15		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	31	1	Riffle	5	3	15	0.18	0.28	35	2	3			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	32	5	Pool	7.5	3.2	24	0.33	0.52	3	1	4	16		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	33	1	Riffle	5	3	15	0.18	0.28	35					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	34	3	Flatwater	23.6	2.6	61.36	0.36	0.53	25	2	8			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	35	1	Riffle	5	3	15	0.18	0.28	35					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	36	5	Pool	8.9	4.2	37.38	0.45	0.79	3		85	16		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	37	3	Flatwater	11.5	2.6	29.9	0.36	0.53	25					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	38	1	Riffle	7	3	21	0.18	0.28	35					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	39	3	Flatwater	8	3.4	27.2	0.34	0.43	3	2	75		29	0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	4	1	Riffle	8	3.8	3.4	0.18	0.26	2	15	85			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	41	4	Pool	8.8	3.6	31.68	0.25	0.37	25	25	6	16.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	42	1	Riffle	6.5	3.8	24.7	0.18	0.26	2					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	43	5	Pool	6	4.3	25.8	0.59	0.73	4	3	4	16		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	44	1	Riffle	13	3.8	49.4	0.18	0.26	2					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	45	3	Flatwater	32	3.4	18.8	0.34	0.43	3					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	46	4	Pool	11	2.9	31.9	0.38	0.62	25		7	16.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	47	1	Riffle	12	3.8	45.6	0.18	0.26	2					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	48	5	Pool	9	3.2	28.8	0.40	0.55	55	35	7	16.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	49	1	Riffle	7.6	3.1	23.56	0.17	0.24	45	4	7		31	0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	50	5	Pool	4.4	3.6	15.84	0.26	0.38	1	1	6	16.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	51	5	Pool	9.7	4.6	44.62	0.34	0.52	35	3	85	16.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	52	2	Cascade	16	5.4	86.4	0.24	0.40	55	45	8			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	53	5	Pool	12	4.2	5.4	0.34	0.52	85	65	7	16.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	54	1	Riffle	4.7	3.1	14.57	0.17	0.24	45					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	54.1	6	Pool	3.5	2	7	0.24	0.35	2					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	55	2	Cascade	1.6	5.4	57.24	0.24	0.40	55					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	56	5	Pool	14	4.7	65.8	0.27	0.55	4	3	9	16.5		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	57	2	Cascade	18	5.4	97.2	0.24	0.40	55				31	0.26	3080	7	0.49	4.01	8.75

2.3	2-7%, 10-100km2	S021	Bear Cr	58	4	Pool	2.5	4.4	9.2	0.40	0.76	5	3	7	17		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	59	1	Riffle	6.5	3.3	21.45	0.18	0.35	17	1	7			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	60	5	Pool	1	2.3	23	0.29	0.55	3	25	4	17		0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	61	2	Cascade	21	4.6	96.6	0.28	0.49	5	25	7			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	62	3	Flatwater	13.5	3.6	48.6	0.27	0.36	5	5	4			0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	63	2	Cascade	13	4.6	59.8	0.28	0.49	5					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	64	1	Riffle	5.3	3.3	17.49	0.18	0.35	17					0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S021	Bear Cr	65	5	Pool	7.2	4	28.8	0.79	1.23	4	2	8	17	29	0.26	3080	7	0.49	4.01	8.75
2.3	2-7%, 10-100km2	S189	Anderson Cr	1	4	Pool	7.1	3.41	24.211	0.27	0.37	4	5	1	15.5	26.7	0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	2	1	Riffle	5.8	1.99	11.542	0.23	0.27	15	5	1				3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	3	5	Pool	14.8	4.1	6.68	0.35	0.61	3	2	5	15.5		0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	4	1	Riffle	38	4.2	159.6	0.25	0.29	2						3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	5	4	Pool	6.2	2.9	17.98	0.49	0.55	5			15.5		0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	6	1	Riffle	27	2.88	77.76	0.25	0.45	1						3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	6.1	6	Pool	15	2	3	0.33	0.48	5	2	2	15.5		0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	7	3	Flatwater	5.5	4.3	217.15	0.35	0.43	5	25	25				3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	8	4	Pool	17.5	3.88	67.9	0.41	0.59	4			15.5		0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	9	1	Riffle	18.8	5.96	112.48	0.23	0.34	6						3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	10	4	Pool	18.5	4.7	86.95	0.68	0.76	4	5	65	15.5	28	0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	11	1	Riffle	5	3	15	0.23	0.32	3	15					3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	12	4	Pool	6.5	4.1	26.65	0.43	0.58	5			15.5		0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	13	1	Riffle	8	6	48	0.27	0.34	1						3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	14	4	Pool	19	5	95	0.46	0.58	3			15.5		0.33	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	15	3	Flatwater	72	6	432	0.27	0.37	3	1	6				3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	16	4	Pool	6.2	3.38	2.956	0.34	0.40	6			15.5		0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	17	3	Flatwater	87.5	5.2	455	0.32	0.48	2						3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	18	4	Pool	12.5	4.8	6	0.78	1.36	4		75	15.5		0.33	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	19	3	Flatwater	75	6.1	457.5	0.39	0.55	4						3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	20	5	Pool	8.6	5.7	49.2	0.68	0.91	4	1	15	15.5	29.5	0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	21	1	Riffle	32	5.7	182.4	0.28	0.35	5	3	7				3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	22	4	Pool	17.5	6.6	115.5	0.73	0.79	45	35	85	15.5		0.17	3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S189	Anderson Cr	23	1	Riffle	33	6.53	215.49	0.26	0.49	4						3038	6.5	0.43	1.64	6
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	1	1	Riffle	39	4.5	175.5	0.21	0.40	35	25	95	14.5	16.5		2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	2	4	Pool	19.5	3.7	72.15	0.27	0.43	45	2	95			0.17	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	3	1	Riffle	6.4	4.5	271.8	0.21	0.40	3			14.5			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	4	4	Pool	1.5	3.5	36.75	0.38	0.43	25	5	95			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	5	1	Riffle	32.4	4.5	145.8	0.21	0.40	3			15			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	6	4	Pool	13	3.3	42.9	0.49	0.49	35	2	95			0.17	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	7	1	Riffle	32.5	3.5	113.75	0.21	0.40	3			15			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	8	4	Pool	9.5	4.8	45.6	1.58	1.58	8	45	7			0.50	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	9	1	Riffle	7.5	3.5	26.25	0.21	0.40	3			15			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	1	5	Pool	9.7	3	29.1	0.76	0.76	4	35	95	15		0.50	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	11	5	Pool	5.8	3.5	2.3	0.37	0.55	3	2	25		20	0.50	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	12	1	Riffle	14.8	2.9	42.92	0.18	0.46	3	15	45	15			2673	8.1	1.51	3.06	5.5

2.3	2-7%, 10-100km2	S131	Bear Cr Upper	13	4	Pool	1.2	6.2	63.24	0.44	1.19	45	3	95			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	14	3	Flatwater	19	5	95	0.24	0.46	35	3	75	15.5			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	15	4	Pool	23.5	4	94	0.41	0.98	55	25	7			0.50	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	16	1	Riffle	8.6	2.9	24.94	0.18	0.46	3			15.5			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	17	5	Pool	9.7	3.4	32.98	0.26	0.57	35	3	1			0.67	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	18	2	Cascade	5	2.2	11	0.23	0.46	65	5	95				2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	19	3	Flatwater	38	2.9	11.2	0.18	0.46	3			16			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	2	5	Pool	1	4.1	41	0.35	0.79	45	25	95			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	21	1	Riffle	9.5	3.5	33.25	0.18	0.35	25	2	95		22		2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	22	3	Flatwater	46	3.8	174.8	0.24	0.49	3	15	95	16			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	23	4	Pool	14	4.1	57.4	0.32	0.65	4	2	95			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	24	1	Riffle	16.2	3.5	56.7	0.18	0.35	3			16.5			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	25	5	Pool	5.9	4.5	26.55	0.24	0.49	25	1	95			0.17	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	26	3	Flatwater	23	3.8	87.4	0.24	0.49	3			16.5			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	27	5	Pool	8.5	4.2	35.7	0.35	0.52	35	15	95			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	28	1	Riffle	3.5	3.5	12.25	0.18	0.35	3			16.5			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	29	5	Pool	5	4.3	21.5	0.26	0.52	15	15	95			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	3	3	Flatwater	44	3.8	167.2	0.24	0.49	3			16.5			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	31	4	Pool	9	5.6	5.4	0.41	0.79	4	3	95		25	0.17	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	32	1	Riffle	1	5	5	0.15	0.21	3	25	95				2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	33	3	Flatwater	14.4	5	72	0.18	0.37	15	1	9				2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	34	1	Riffle	12	5	6	0.15	0.21	3			16.5			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	35	5	Pool	6.1	3.3	2.13	0.21	0.70	4	1	95			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	36	1	Riffle	1	3.4	34	0.15	0.21	3			17			2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	37	5	Pool	6.5	3.6	23.4	0.15	0.65	25	1	8			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	38	3	Flatwater	35	3.4	119	0.18	0.37	1						2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	39	5	Pool	7	3.8	26.6	0.40	0.55	4	35	95			0.33	2673	8.1	1.51	3.06	5.5
2.3	2-7%, 10-100km2	S131	Bear Cr Upper	4	1	Riffle	1	5	5	0.15	0.21	3						2673	8.1	1.51	3.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	1	5	Pool	5.29	2.9	15.341	0.38	0.62	20	15	90	13.5	25.5	0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	2	3	Flatwater	12	2.2	26.4	0.21	0.30	15	10	90			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	3	5	Pool	6.7	5.58	37.386	0.56	0.82	30					0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	4	2	Cascade	52.8	2.54	134.112	0.42	0.76	30	15	75			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	5	5	Pool	4.7	2.7	12.69	0.46	0.55	21					0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	6	1	Riffle	8.6	2.4	20.64	0.13	0.16	25	5	80			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	6.1	6	Pool	4.3	1.95	8.385	0.39	0.60	50	30	90			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	7	4	Pool	7.5	2.56	19.2	0.54	0.75	30	5	80			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	8	3	Flatwater	113	2.7	305.1	0.21	0.37	15		60			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	9	2	Cascade	20.7	2.6	53.82	0.20	0.27	30					0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	10	4	Pool	6.58	3.46	22.7668	0.24	0.47	25	5	55		26.7	0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	11	1	Riffle	8.04	2.9	23.316	0.18	0.20	15	10	80			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	12	3	Flatwater	15.3	3.3	50.49	0.31	0.52	15	5	70			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	13	1	Riffle	40	4.12	164.8	0.24	0.43	15					0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	14	4	Pool	8.96	3.55	31.808	0.41	0.80	25					0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	15	2	Cascade	51.5	2.2	113.3	0.28	0.46	35	20	75			0.26	1531		0.33	0.06	5.5

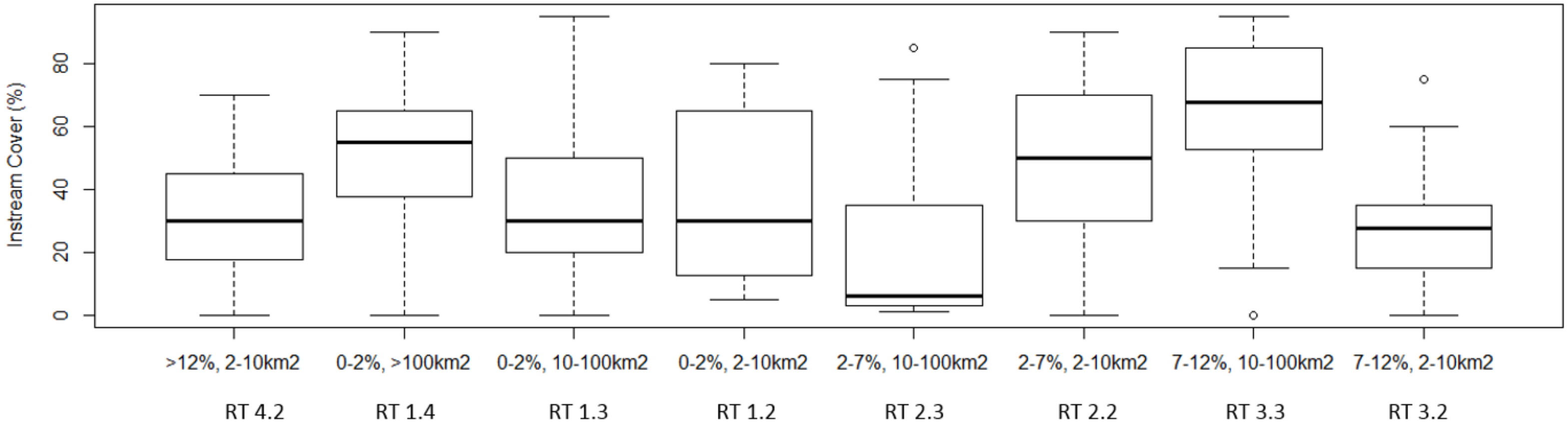
3.2	7-12%, 2-10km2	S123	Horse Cr	16	5	Pool	5.75	2.6	14.95	0.34	0.56	35	10	10			0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	17	2	Cascade	55.8	3.83	213.714	0.30	0.46	35					0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	18	4	Pool	8.7	4	34.8	0.36	0.49	30					0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S123	Horse Cr	19	3	Flatwater	99	2.3	227.7	0.29	0.40	15					0.26	1531		0.33	0.06	5.5
3.2	7-12%, 2-10km2	S188	Willow Cr	1	1	Riffle	7.9	1.5	11.85	0.09	0.17	30	15	45		35	0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	2	2	Cascade	10	3.33	33.3	0.19	0.29	25	15	15			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	3	1	Riffle	17.5	1.6	28	0.16	0.27	30	10	35			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	4	7	Dry	4.8	0	0	0.00	0.00	0					0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	5	5	Pool	4.1	5.65	23.165	0.12	0.16	30	0	45	15		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	6	1	Riffle	12.7	2.45	31.115	0.09	0.15	10	10	85			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	7	4	Pool	4.2	3.8	15.96	0.19	0.26	30	15	95	15		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	8	1	Riffle	9	1.67	15.03	0.09	0.14	10	10				0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	9	4	Pool	5.3	2.73	14.469	0.37	0.59	20	15	95	15		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	10	3	Flatwater	12.5	2.6	32.5	0.19	0.30	30					0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	11	4	Pool	5	2	10	0.50	0.70	40	35	95	14	36	0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	12	1	Riffle	2	2	4	0.15	0.18	20	20	95			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	13	4	Pool	6	2.2	13.2	0.51	0.77	40		95	15		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	14	1	Riffle	3.8	2.07	7.866	0.09	0.15	10		90			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	15	5	Pool	3.8	4	15.2	0.37	0.70	45	30	95	14		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	16	1	Riffle	4	1.05	4.2	0.21	0.46	10					0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	17	5	Pool	6	2.93	17.58	0.53	1.02	75	20	85	14		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	18	3	Flatwater	4.5	2.2	9.9	0.27	0.40	40	15	80			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	19	1	Riffle	20.5	2.6	53.3	0.21	0.34	50	10				0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	20	5	Pool	8	2	16	0.27	0.38	35	15	80	15		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	21	1	Riffle	20.5	1.27	26.035	0.17	0.26	50	35	80		35	0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	22	5	Pool	7	2.75	19.25	0.32	0.54	55	35	80	14		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	23	2	Cascade	38	1.96	74.48	0.20	0.28	30	30	85			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	24	7	Dry	6.7		0	0.00	0.00	0					0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	25	5	Pool	3.6	1.3	4.68	0.17	0.20	50		80			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	26	2	Cascade	17.2	2.03	34.916	0.25	0.40	20		75			0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	27	5	Pool	10.5	2.07	21.735	0.23	0.47	60		95	15		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	28	2	Cascade	15	2.17	32.55	0.23	0.43	25					0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	28.1	6	Pool	3	2.5	7.5	0.25	0.41	10	5	95	13		0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	29	7	Dry	6.8	0	0	0.00	0.00	0					0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	30	5	Pool	1.5	1.4	2.1	0.23	0.31	10	10	90	13.5	32.2	0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	31	7	Dry	14.8	0	0	0.00	0.00	0	0				0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	32	2	Cascade	17	1.6	27.2	0.32	0.51	30	30				0.22	607			0.02	4.25
3.2	7-12%, 2-10km2	S188	Willow Cr	33	7	Dry	53	0	0	0.00	0.00	0	0				0.22	607			0.02	4.25
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	1	5	Pool	4	4.5	18	0.49	0.65	80	75	35	16	25	0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	1.1	1	Riffle	6	3	18	0.18	0.30	75	50	45			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	2	2	Cascade	11	7.9	86.9	0.47	0.79	95	70	60			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	3	5	Pool	5.5	5.3	29.15	0.43	0.67	90	75	5			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	4	5	Pool	6.7	4.8	32.16	0.50	0.79	85	75	2			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	5	5	Pool	4.3	3.6	15.48	0.49	0.67	95	75	35			0.34	2124	8.24	1.16	0.63	6.5

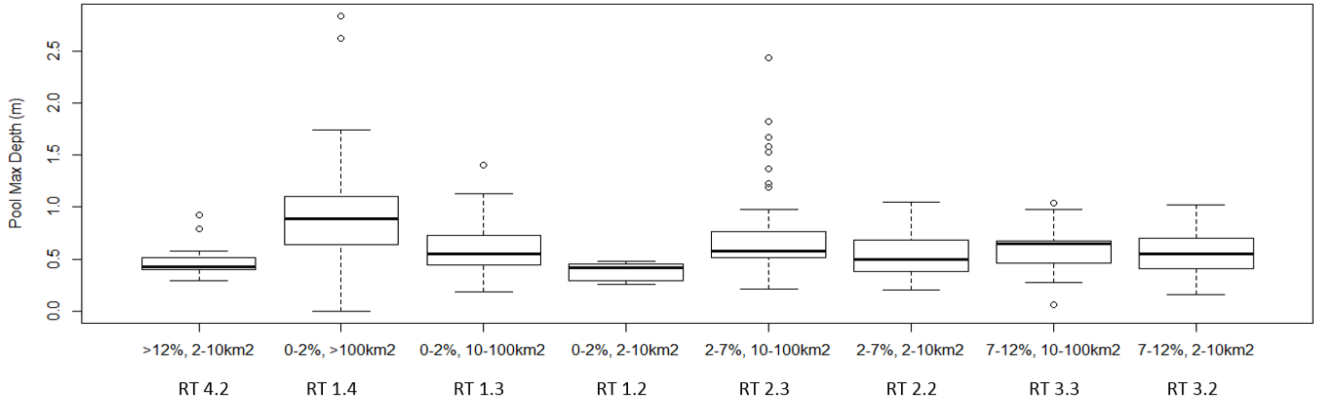
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	6	2	Cascade	43.5	7.9	343.65	0.47	0.79	90	25				0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	7	4	Pool	5	3	15	0.37	0.49	60	35	45			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	8	2	Cascade	15.3	1.5	22.95	0.12	0.18	55	10	7			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	9	5	Pool	8	0.65	5.2	0.29	0.67	50	25	35			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	10	1	Riffle	3.5	1.8	6.3	0.11	0.27	25	10	70	18.2	29	0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	11	4	Pool	7	3.6	25.2	0.73	0.98	85	70	70			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	12	1	Riffle	10.7	1.8	19.26	0.11	0.27	25					0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	13	3	Flatwater	15.3	3.6	55.08	0.15	0.34	20	10	20			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	13.1	6	Pool	2	2	4	0.23	0.27	15	10	60			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	14	3	Flatwater	11	3.6	39.6	0.15	0.34	30					0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	15	4	Pool	8.5	4	34	0.27	0.37	55	45	80			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	16	3	Flatwater	7.8	3.6	28.08	0.15	0.27	20					0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	17	5	Pool	8.2	3.6	29.52	0.43	0.06	85	70	60			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	18	5	Pool	8.2	4.6	37.72	0.53	0.58	60	50	75			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	19	2	Cascade	29.5	3.8	112.1	0.23	0.34	60	40	70	19	30	0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	20	4	Pool	4.3	6.2	26.66	0.18	0.70	60	35	55			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	21	2	Cascade	48	3.8	182.4	0.23	0.34	60	45	0			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	22	5	Pool	9	4.2	37.8	0.46	0.66	80	10	30			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	23	2	Cascade	7.5	3.8	28.5	0.23	0.34	70		0			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	24	5	Pool	10	3.6	36	0.40	0.64	90	65	35			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	25	2	Cascade	31	3.8	117.8	0.23	0.34	70		0			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	26	5	Pool	3.6	4.1	14.76	0.69	1.04	75	45	70			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	27	5	Pool	5.2	4.2	21.84	0.43	0.67	70	55	25			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	28	1	Riffle	4	1	4	0.49	0.64	30		25			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	29	4	Pool	8.8	4.2	36.96	0.53	0.70	55	35	80	19	30	0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	30	1	Riffle	24	7	168	0.20	0.76	90	10	2			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	31	5	Pool	6	2	12	0.38	0.43	60	25	30			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	32	2	Cascade	8.8	1.8	15.84	0.24	0.40	80	55	70			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	33	1	Riffle	22.5	2.5	56.25	0.20	0.76	90					0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	34	5	Pool	5	2.4	12	0.23	0.37	55	20	45			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	35	3	Flatwater	10	2.3	23	0.23	0.37	70	40	70			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	36	1	Riffle	12	2.5	30	0.20	0.76	90					0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	37	3	Flatwater	5.8	2.3	13.34	0.23	0.37	70					0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	38	4	Pool	4.5	2.6	11.7	0.37	0.49	25	25	35			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	39	1	Riffle	34.6	3.9	134.94	0.18	0.34	65	25	60	19	30	0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	40	4	Pool	7.5	3.4	25.5	0.38	0.58	45	20	75			0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	41	1	Riffle	26	3.9	101.4	0.18	0.30	0					0.34	2124	8.24	1.16	0.63	6.5
3.3	7-12%, 10-100km2	S202	Skeleton Glade Cr	42	5	Pool	9	4	36	0.30	0.46	95	70	30			0.34	2124	8.24	1.16	0.63	6.5
4.2	>12%, 2-10km2	S235	Soda Cr	1	7	Dry	19.8	0	0	0.00	0.00	0				24	0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	2	2	Cascade	17	1.4	23.8	0.25	0.34	45	20	75			0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	3	5	Pool	5.2	2.27	11.804	0.28	0.50	35	30	60	16		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	4	2	Cascade	37	1.4	51.8	0.26	0.34	45					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	5	1	Riffle	15	1.57	23.55	0.10	0.17	40	30	95			0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	6	7	Dry	8	0	0	0.00	0.00	0					0.22	677	6.5	0.71	0.05	5.5

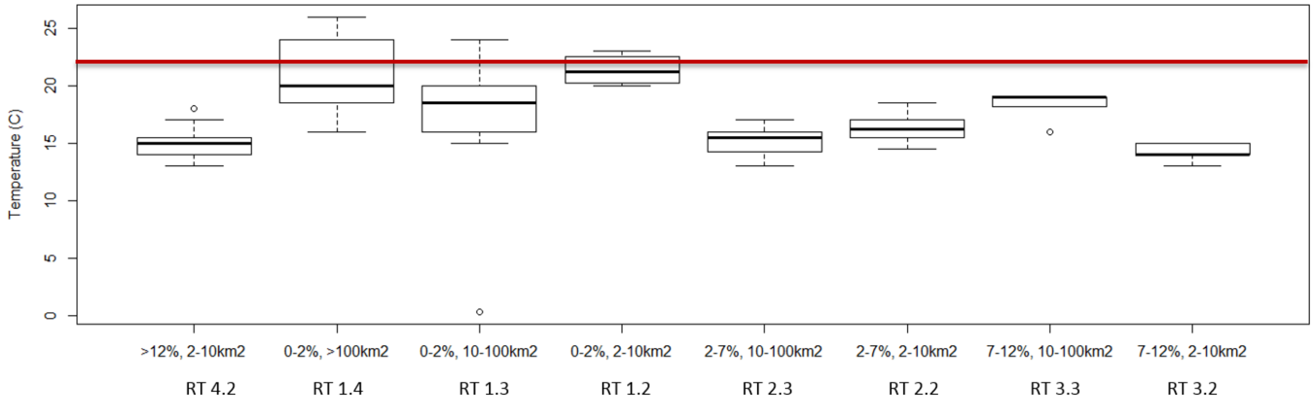
4.2	>12%, 2-10km2	S235	Soda Cr	7	2	Cascade	21	1.4	29.4	0.25	0.34	50					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	8	5	Pool	4.5	2.4	10.8	0.34	0.45	30	25	80	15		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	9	1	Riffle	15	1.57	23.55	0.10	0.17	15					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	10	4	Pool	4.8	2	9.6	0.15	0.29	10	10	60	16		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	11	1	Riffle	5	1	5	0.07	0.08	25	20	50		26	0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	12	5	Pool	5	2.5	12.5	0.20	0.32	25	20	15	15.5		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	13	7	Dry	38		0	0.00	0.00	0	0				0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	14	5	Pool	6.5	1.93	12.545	0.25	0.35	40	40	85	15		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	15	2	Cascade	19	1.5	28.5	0.24	0.40	40	0	40			0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	16	7	Dry	4.5		0	0.00	0.00	0	0				0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	17	1	Riffle	10.5	1	10.5	0.07	0.08	25	0				0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	18	4	Pool	5.5	2.8	15.4	0.49	0.79	50	45	90	15		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	19	7	Dry	45		0	0.00	0.00	0	0				0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	20	5	Pool	1.7	1.5	2.55	0.34	0.40	55	40	90	14		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	21	1	Riffle	3.5	1.35	4.725	0.10	0.18	25	25	95		27	0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	22	5	Pool	4.2	3.75	15.75	0.30	0.52	30	30	90	13.5		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	23	2	Cascade	15	1.2	18	0.26	0.50	70	65	90			0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	24	4	Pool	4.6	2.17	9.982	0.29	0.43	20	20	85	14.5		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	25	2	Cascade	12	1.2	14.4	0.27	0.50	60					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	26	5	Pool	4.8	4.7	22.56	0.56	0.92	50	50	90	13.5		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	27	2	Cascade	41.5	1.9	78.85	0.25	0.50	65					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	27.1	6	Pool	3.8	2.1	7.98	0.30	0.41	35	20	95	14		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	28	5	Pool	5	3	15	0.44	0.58	40		95	15		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	29	1	Riffle	5.5	1.4	7.7	0.11	0.18	25					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	30	5	Pool	2.8	1.2	3.36	0.23	0.31	25	15	95	15	29	0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	31	7	Dry	34.5		0	0.00	0.00	0					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	32	5	Pool	3.6	2	7.2	0.24	0.43	25	25	5	18		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	33	7	Dry	37.5		0	0.00	0.00	0					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	34	2	Cascade	7.3	1.75	12.775	0.12	0.20	45	45	95			0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	35	5	Pool	5.8	3.55	20.59	0.31	0.53	30	30	90	13.5		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	36	2	Cascade	28	1.75	49	0.12	0.20	50					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	37	7	Dry	48.5		0	0.00	0.00	0					0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	37.1	6	Pool	4	2.8	11.2	0.32	0.40	25	15	95	13		0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	38	1	Riffle	15	2.3	34.5	0.18	0.26	60	20	80			0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	39	5	Pool	5.5	2.65	14.575	0.27	0.46	20	10	70	17	28	0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	40	1	Riffle	22	2.6	57.2	0.18	0.20	55	30	85			0.22	677	6.5	0.71	0.05	5.5
4.2	>12%, 2-10km2	S235	Soda Cr	41	7	Dry	20.3		0	0.00	0.00	0	0				0.22	677	6.5	0.71	0.05	5.5

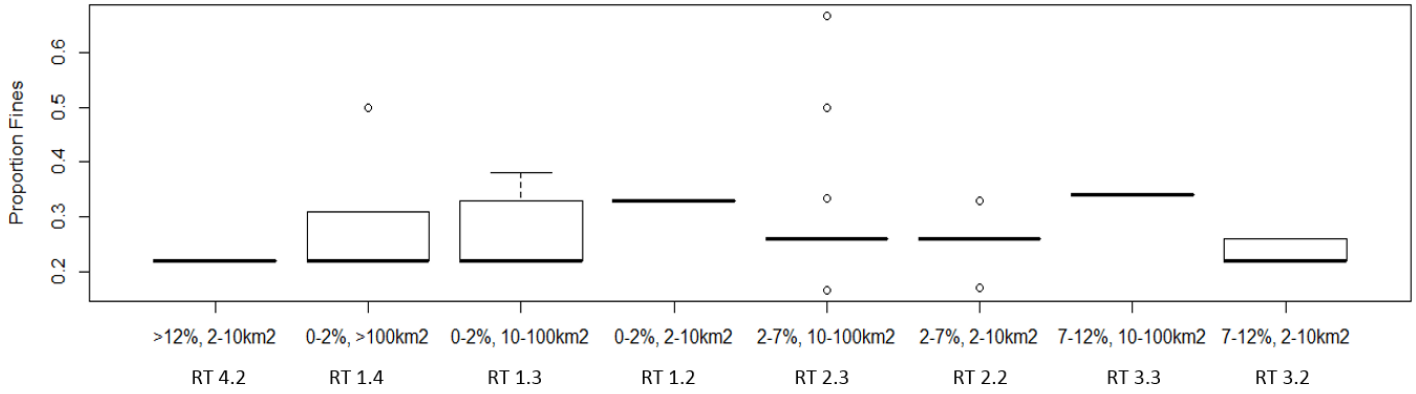
APPENDIX H

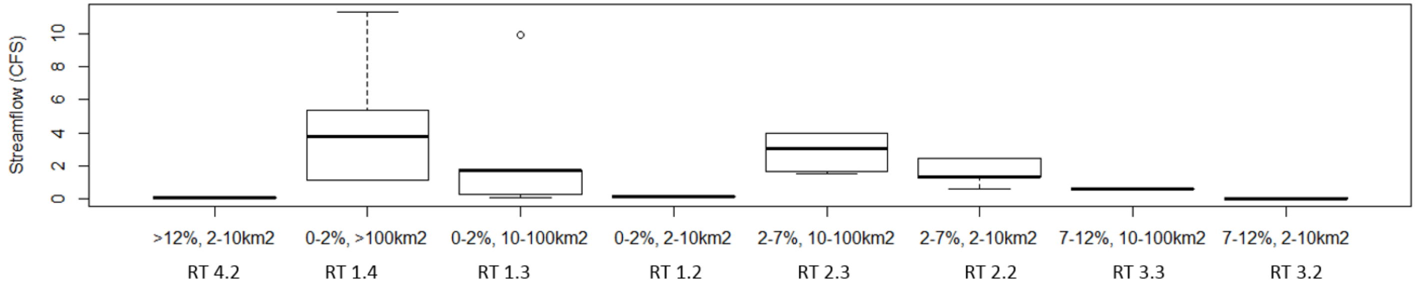
Appendix H: Summarized habitat data. The red line in temperature plot indicates a threshold for unsuitable stream temperature for salmonids.

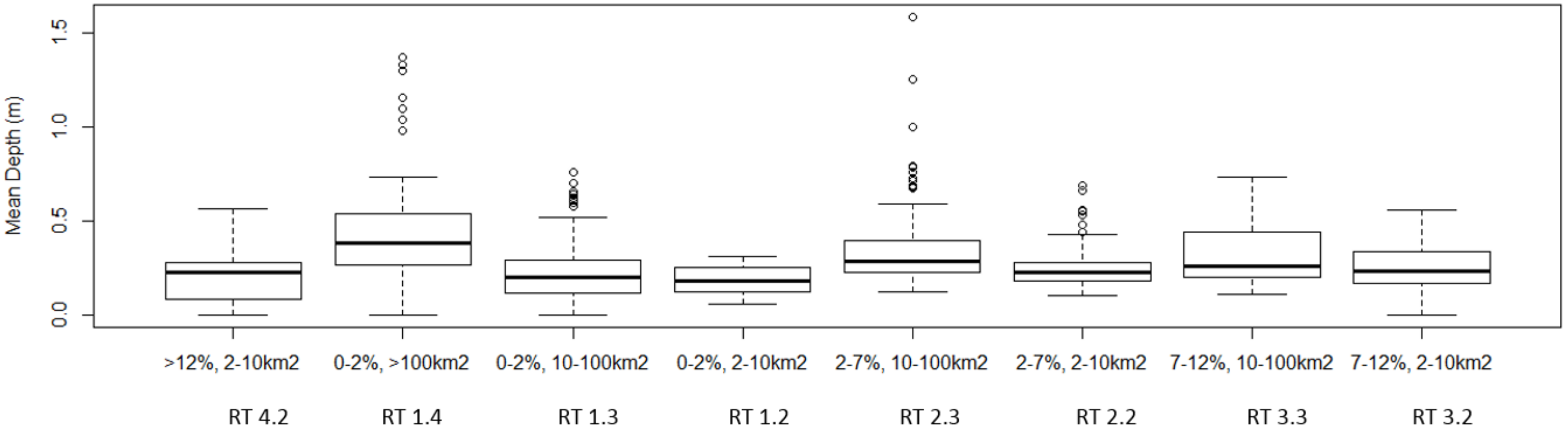



Pool Max Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
>12%, 2-10km2
0-2%, >100km2
0-2%, 10-100km2
0-2%, 2-10km2
2-7%, 10-100km2
2-7%, 2-10km2
7-12%, 10-100km2
7-12%, 2-10km2
RT 4.2
RT 1.4
RT 1.3
RT 1.2
RT 2.3
RT 2.2
RT 3.3
RT 3.2


Temperature (C)
0
5
10
15
20
25
>12%, 2-10km2
0-2%, >100km2
0-2%, 10-100km2
0-2%, 2-10km2
2-7%, 10-100km2
2-7%, 2-10km2
7-12%, 10-100km2
7-12%, 2-10km2
RT 4.2
RT 1.4
RT 1.3
RT 1.2
RT 2.3
RT 2.2
RT 3.3
RT 3.2


Proportion Fines
0.2
0.3
0.4
0.5
0.6
>12%, 2-10km2
0-2%, >100km2
0-2%, 10-100km2
0-2%, 2-10km2
2-7%, 10-100km2
2-7%, 2-10km2
7-12%, 10-100km2
7-12%, 2-10km2
RT 4.2
RT 1.4
RT 1.3
RT 1.2
RT 2.3
RT 2.2
RT 3.3
RT 3.2


Streamflow (CFS)
0
2
4
6
8
10
>12%, 2-10km2
0-2%, >100km2
0-2%, 10-100km2
0-2%, 2-10km2
2-7%, 10-100km2
2-7%, 2-10km2
7-12%, 10-100km2
7-12%, 2-10km2
RT 4.2
RT 1.4
RT 1.3
RT 1.2
RT 2.3
RT 2.2
RT 3.3
RT 3.2


Mean Depth (m)
0.0
0.5
1.0
1.5
>12%, 2-10km2
0-2%, >100km2
0-2%, 10-100km2
0-2%, 2-10km2
2-7%, 10-100km2
2-7%, 2-10km2
7-12%, 10-100km2
7-12%, 2-10km2
RT 4.2
RT 1.4
RT 1.3
RT 1.2
RT 2.3
RT 2.2
RT 3.3
RT 3.2

APPENDIX I

Appendix I: Fieldwork Photos

Corbin Creek, looking upstream

Rice Creek, looking upstream

Bear Creek (lower), looking upstream

Bear Creek (upper), looking upstream

Bear Creek (upper), looking upstream

Cold Creek, looking upstream

Skeleton Glade, looking downstream

Soda Creek, looking upstream

Smokehouse Creek, looking upstream

Mainstem at Rattlesnake Creek, looking upstream

Mainstem at Copper Butte Creek, looking upstream

Bloody Rock Roughs, looking upstream; 20 February 2016; 11.50 cubic m/s, or 400 cfs (Photo: Erik Kenas)

Bloody Rock Roughs, looking upstream; 20 February 2016; 11.50 cubic m/s, or 400 cfs (Photo: Erik Kenas)

Bloody Rock roughs, looking upstream; 17 May 2016; 1.64 cms, or 58 cfs