Yellow Creek Summary Report
October 14-17, 2008

Heritage and Wild Trout Program
California Department of Fish and Game

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Introduction:

A fisheries and habitat assessment of Yellow Creek was conducted by the California Department of Fish and Game's (DFG) Heritage and Wild Trout Program (HWTP) in October, 2008. Yellow Creek (Plumas County) originates in the vicinity of Eagle Rocks near the intersection of Tehama, Butte, and Plumas Counties to the west of Lake Almanor. Yellow Creek flows east into Humbug Valley and then heads in a southerly direction to the confluence with the North Fork Feather River (Figure 1) and is a west slope draining Sierra Nevada stream. Fifteen miles of Yellow Creek is designated by the California Fish and Game Commission as a Wild Trout Water from Big Springs downstream to the confluence with the North Fork Feather River (Figure 2) and supports wild populations of coastal rainbow trout (*Oncorhynchus mykiss irideus*), brown trout (*Salmo trutta*), and brook trout (*Salvelinus fontinalis*). The HWTP is responsible for monitoring this fishery and, in 2008, conducted Phase 4 (ongoing monitoring) electrofishing surveys and habitat assessments on four sections of Yellow Creek in order to document the current status of the wild trout fishery. This report summarizes the results of the 2008 surveys.

Methods:

Surveys were conducted on Yellow Creek between October 14 and 17, 2008 in Humbug Valley. Four sections were surveyed (Figure 3) and two different survey methods were employed: single and multiple pass electrofishing.

Multiple Pass Electrofishing

Multiple pass electrofishing was used to generate population data including species composition, size and age class structure, and estimates of biomass and density. In 2008, three survey sections (Sections 108, 208, and 308) were randomly selected in Humbug Valley (within the Wild Trout-designated area). Sections were examined for survey feasibility by HWTP North Central Regional staff prior to the electrofishing effort. To estimate population size, the Lincoln-Peterson mark-recapture method was utilized. This analysis method requires two electrofishing passes. The first pass (mark phase) was used to mark a known number of fish which were released back into the section after processing. Following a recovery period of approximately 12 hours, we conducted a second pass (recapture phase) and determined the proportion of captured fish that had been previously marked (we conducted the first pass in each section in the afternoon and conducted the second pass in the morning of the following day). This method assumes a closed population (no births, deaths, emigration or immigration), that all individuals have an equal probability of being recaptured, and there is a random distribution of marked and unmarked individuals.

Fish were captured using backpack and tote barge electroshockers. Physical measurements of the stream and environmental conditions were taken, including air and water temperature (in the shade) and conductivity (both specific and ambient). These factors were used to determine appropriate electroshocker settings. GPS coordinates were recorded for both the upstream and downstream boundaries of the survey sections.

Current weather conditions were noted and the area was scouted for any species of concern prior to commencing the surveys.

In each section, at the start of each pass, we positioned backpack electroshockers across the wetted width at the downstream boundary of the section. These shockers formed an "electric fence" across the wetted width to block the movement of fish into or out of the section. A tote barge began at the downstream boundary of the section and proceeded upstream with netters capturing fish and placing them in live cars to be held until processed. Live cars are 50 gallon plastic trash bins, perforated with holes to allow water circulation. When the tote barge reached a distance upstream of the electric fence of approximately 50 feet, the backpack shockers moved upstream next to the anodes of the tote barge and assisted in capturing fish. This continued throughout the section until the upstream boundary of the section was within 50 feet. The backpack shockers then discontinued their capture effort and moved upstream to the upper section boundary and again formed an electric fence to limit the movement of fish into or out of the section. This less than ideal method was utilized due to the amount of aquatic vegetation, nature of the channel profile (deep u-shaped channel with undercut banks), and flow velocity in Humbug Valley, which prevented secure placement of block nets to close off the section for the duration of the survey.

At the end of each pass, each fish was identified to species and was measured from head to tail (total length in millimeters) and weights were measured using a digital scale (in grams). Over the course of the survey, fish were handled carefully to minimize injury and stress. In addition, fish captured in Pass 1 were marked with a fin clip. To differentiate fish marked in each section, we utilized a specific fin for each section during the marking phase. Fish captured in pass 2 were examined for fin clips and recorded according to the section they were marked in. Fish were then recovered in live cars secured in the stream (with fresh flowing water) and released back into the section.

To evaluate possible violation of the closed-population assumption, after conducting the second pass in each section, shockers conducted a single pass electrofishing "sweep" both upstream of the upper section boundary and downstream of the lower section boundary. This effort varied in length from 200 to 250 feet (we used visual estimates to determine length). Captured fish were examined for marks and we counted both the number of marked and unmarked fish captured outside of the section. In the absence of a truly closed section (e.g, one closed off by a physical barrier such as block nets at the upstream and downstream boundary for the duration of the survey), this validation effort was performed to determine how many marked fish had migrated outside the sections.

A habitat assessment was conducted in Sections 108, 208, and 308 to document resource condition by collecting base-line data on habitat types and quality, water conditions, substrate, discharge, bank condition, etc. The HWTP habitat assessment is a pared down synthesis of Rosgen (1994) and the California Salmonid Stream Habitat Restoration Manual (CSSHRM) (Flosi et al 1988). Section length was measured along the thalweg. The length of the section was then divided into five cells of equal length. Wetted widths were measured at the center of each of the five cells. Across each width transect, five

depths were taken (also at the center of five evenly divided cells), and both widths and depths were averaged for each section.

Stream characteristics, including active erosion (erosion occurring in the present), erosion at bankful, and canopy closure were measured as percentages of either the total stream area (canopy cover) or bank area (erosion). Section percentages were defined for each habitat type (riffle, flatwater, and pool) following Level II protocols as defined by the CSSHRM. Using visual observation, we quantified substrate size classes and the percentage of each class relative to the total bottom material within the wetted width. A rating (between poor and excellent) was given to the instream cover available to fish and cover types were identified and defined as percentages of total instream cover. The change in water surface elevation (section gradient) was measured and streamflow (cfs) was measured on October 14 in Section 308 and again on October 15 in Section 108. Representative photographs of the sections were taken.

To calculate population estimates for each section (Sections 108, 208, and 308) we used the NOREMARK Closed Population Model Estimation developed by Gary White at Colorado State University Department of Fishery and Wildlife (1996).

Single Pass Electrofishing

Single pass electrofishing was used to document species composition, distribution and size class structure. Section 408, located upstream of the Wild Trout-designated area, was surveyed on October 14, 2008 via single pass electrofishing (Figure 3). Two backpack shockers and two netters began the electrofishing effort at the intersection of Humbug Road and Yellow Creek and surveyed upstream approximately 550 feet (this distance was estimated). Captured fish were placed in a five-gallon bucket, were identified to species, measured to the nearest inch using a calibrated landing net, and were immediately released downstream of the electrofishers.

Figure 1. Maps of Yellow Creek 2008 study area. Maps show general location of Yellow Creek (left), proximity to Lake Almanor (top right), and detail of Humbug Valley (bottom right).

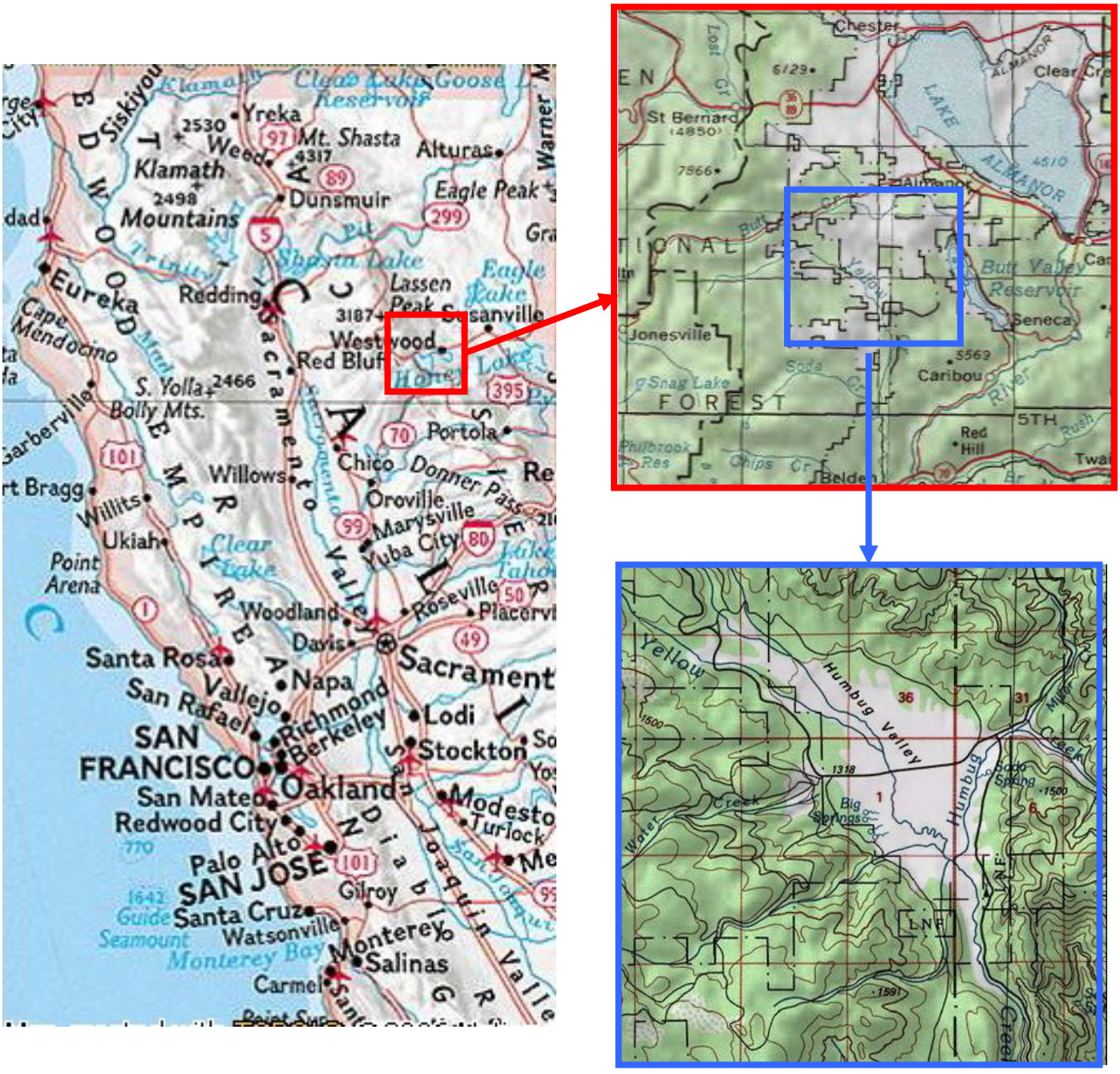


Figure 2. Map of Wild Trout-designated area of Yellow Creek with locations of survey sections (colored dots).

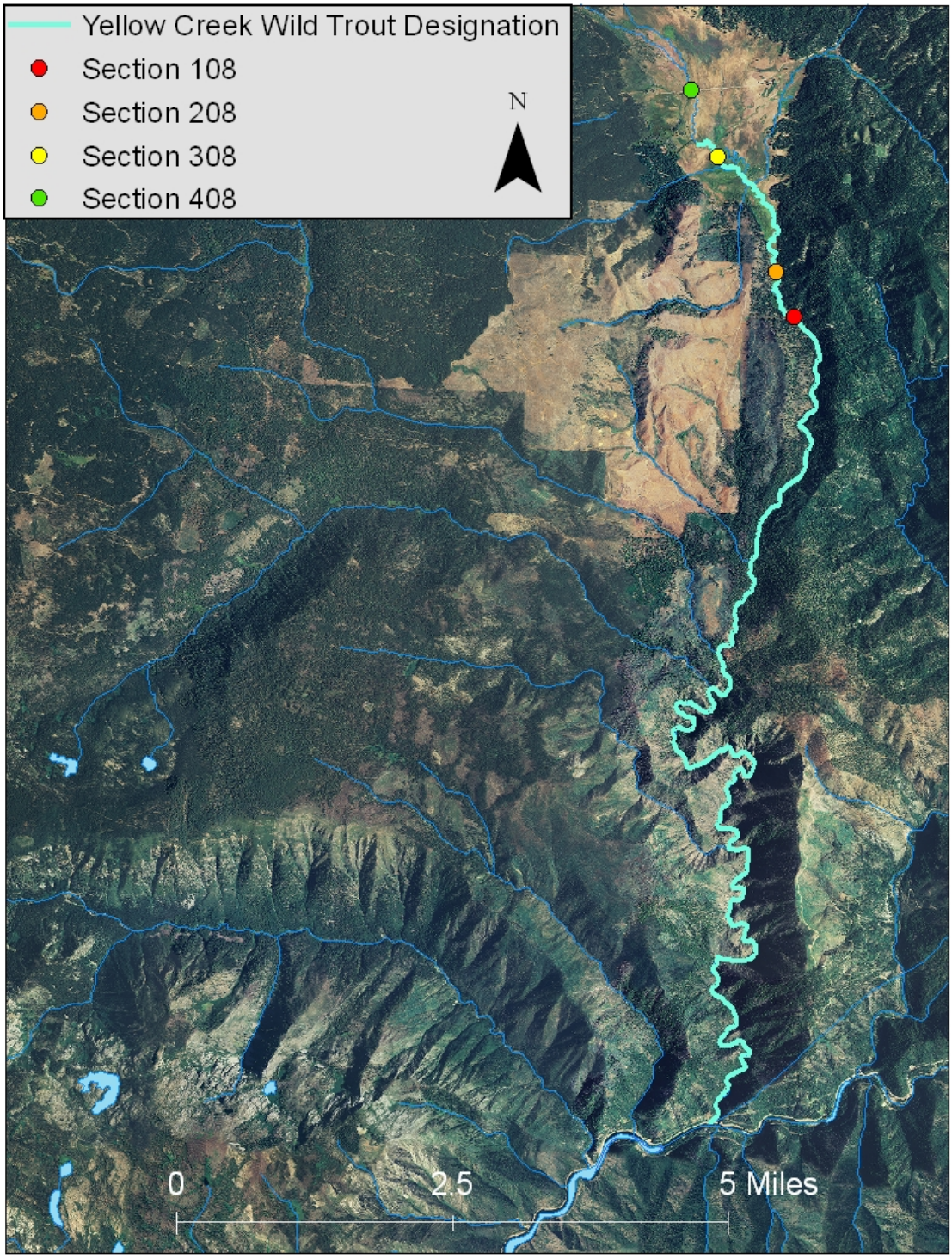
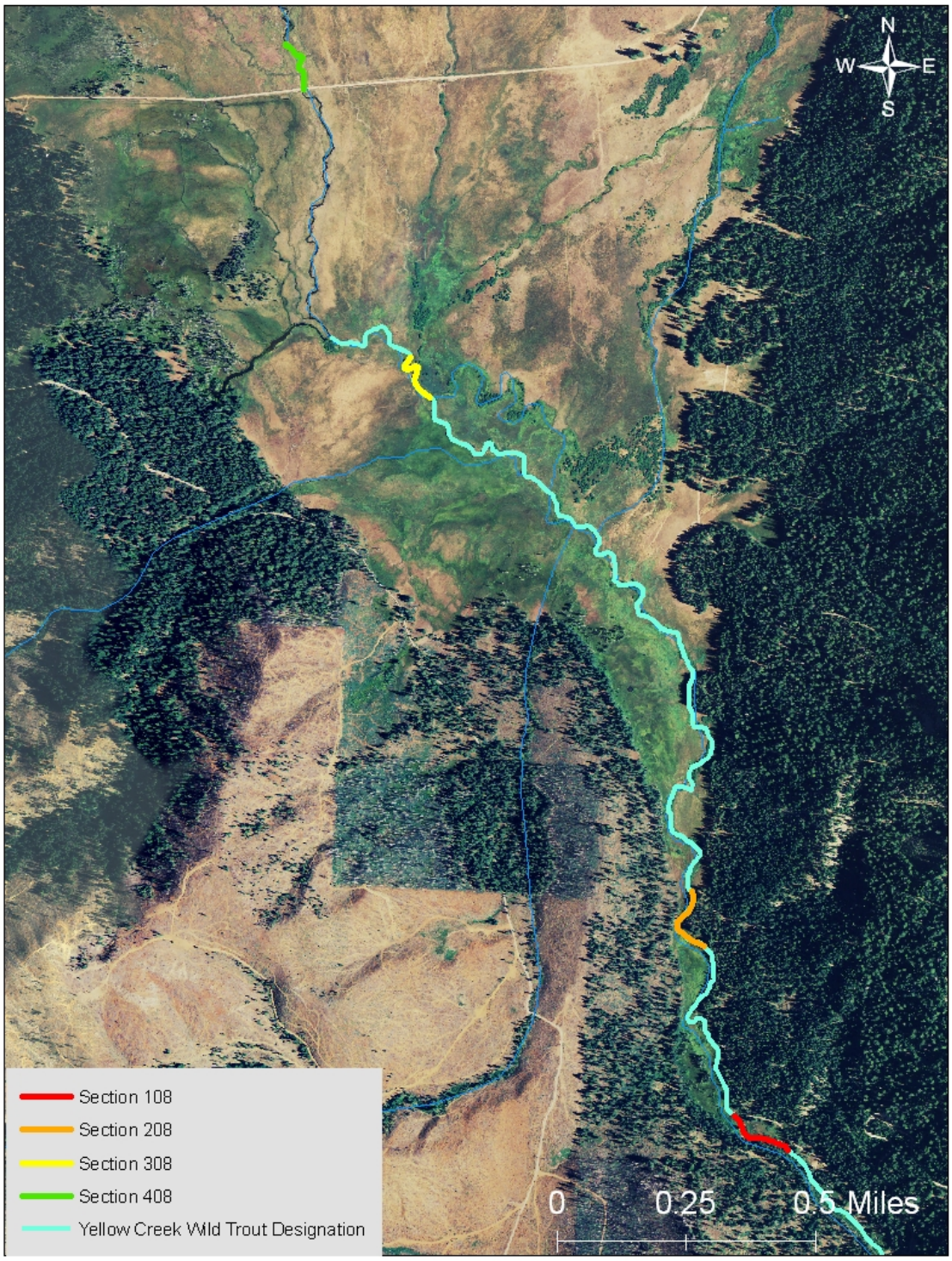


Figure 3. Map of Yellow Creek 2008 survey sections



Results:

Section 108 was surveyed with four backpack electroshockers, one tote barge, and five netters on October 15 and 16, 2008. In pass 1 (October 15), seven coastal rainbow trout, 230 brown trout, and three brook trout were captured (Table 1). All fish were marked with a dorsal fin clip. In pass 2 (October 16), a total of one coastal rainbow trout, 291 brown trout, and two brook trout were captured. Of these fish, 52 brown trout and one brook trout had dorsal fin clips (recaptures). After the completion of the two mark-recapture passes and during the single-pass evaluation of fish movement outside the section boundaries, we captured fish both upstream and downstream of the section. Of these, three captured within 200 feet of the upper section boundary had dorsal fin clips. Zero fish captured downstream of the section had marks.

Section 208 was surveyed with three backpack electroshockers, one tote barge, and five netters on October 16 and 17, 2008. In pass 1 (October 16), we captured one coastal rainbow trout, 321 brown trout, and 11 brook trout (Table 1). All fish from pass 1 were marked with an upper caudal fin clip. During pass 2 (October 17), we captured a total of eight coastal rainbow trout, 241 brown trout, and three brook trout. Of the fish captured in pass 2, 80 of the brown trout had an upper caudal fin clip (recaptures). There were zero recaptures of either coastal rainbow or brook trout. In addition, two of the brown trout captured during the second pass had dorsal fin clips. These fish were counted as unmarked for the purpose of estimating the population in Section 208; however, it is important to note that these fish were marked in Section 108 and had migrated upstream into Section 208. During the evaluation of fish movement outside of the section, we found six fish with upper caudal fin clips within 200 feet of the upper section boundary. No marked fish were captured downstream of the section.

Section 308 was surveyed with three backpack electroshockers, one tote barge, and seven netters on October 14 and 15, 2008. In pass 1 (October 14), we captured 163 brown trout and 81 brook trout and marked each fish by removing the adipose fin. The pass 2 effort (October 15) captured 229 brown trout and 53 brook trout. Of these fish, 43 brown trout and ten brook trout were recaptures (adipose fin clipped). During the single-pass evaluation of fish movement outside of the section, we captured fish both upstream and downstream of the section boundaries. Of these fish, seven brown and two brook trout (captured within 200 feet of the upper section boundary) had adipose fin clips. None of the fish captured downstream of the section had fin marks.

Section 408 was surveyed on October 14 with two backpack electroshockers and two netters. The survey section consisted of flatwater and pool habitat within approximately 550 feet of the Humbug Road (upstream of the Humbug Road Bridge). A total of 23 brown trout and 19 brook trout were captured and measured (total length to the nearest inch) (Table 1). Total lengths ranged from three to ten inches for brown trout and three to seven inches for brook trout. No coastal rainbow trout were captured.

Yellow Creek in the vicinity of Humbug Valley is a low gradient meadow stream (< 1%) with dense mats of aquatic vegetation providing good to excellent fish cover. The

substrate consisted of cobbles and gravels with some fines and silts. Water temperatures during the surveys ranged from five to nine degrees Celsius (C). Air temperatures were measured between 19º and 29º C, depending on the time of day. Habitat was predominantly flatwater with some riffles and pools in the southern end of the meadow. Streamflow measured in Section 108 on October 15, 2008 yielded a discharge of approximately 32 cubic feet per second (cfs). No flow measurements were taken in Section 208; Sections 108 and 208 are relatively close to each other and it was assumed flows were similar in both sections. Discharge in Section 308 was measured on October 14, 2008 at approximately 30 cfs. Water clarity was greater than four feet in all sections and the average wetted width of Sections 108-308 was 30.3 feet. The average water depth was 2.2 feet. Bankful erosion ranged from five to 10 percent and active erosion was between zero and 15 percent. Canopy closure ranged from five to 30 percent. Fish captured during the electrofishing effort included coastal rainbow trout, brown trout, and brook trout. The coastal rainbow trout ranged in size from 50 to 165 millimeters (2.0-6.5 inches), brown trout from 56 to 512 millimeters (2.2-20.2 inches), and brook trout were between 66 and 235 millimeters (2.6-9.3 inches). A density estimate based on the average of Sections 108, 208, and 308 indicates there are approximately 77 coastal rainbow trout per mile, 7797 brown trout per mile, and 1264 brook trout per mile in Yellow Creek within Humbug Valley (Table 2).

Table 1. Summary of Yellow Creek 2008 electrofishing data by section, species, and pass

Section Number	Species	Number of Fish Captured			
		Pass 1	Pass 2		
			Unmarked fish	Marked Fish	Total Fish
108	coastal rainbow trout	7	1	0	1
	brown trout	230	239	52	291
	brook trout	3	1	1	2
208	coastal rainbow trout	1	8	0	8
	brown trout	321	161	80	241
	brook trout	11	3	0	3
308	coastal rainbow trout	0	0	0	0
	brown trout	163	186	43	229
	brook trout	81	43	10	53
408	coastal rainbow trout	0	n/a	n/a	n/a
	brown trout	23	n/a	n/a	n/a
	brook trout	19	n/a	n/a	n/a

Table 2. NOREMARK population estimates including 95% confidence intervals by species and section based on Yellow Creek 2008 electrofishing data

Section Number	Species	Population Estimate	95 % Confidence Interval	Density Estimate (fish per mile)
108	coastal rainbow trout	15.0	0.3-29.7	110
	brown trout	1271.7	1002.1-1541.3	9321
	brook trout	5.0	2.2-7.8	37
208	coastal rainbow trout	17.0	0.4-33.6	120
	brown trout	961.0	814.1-1108.0	6765
	brook trout	47.0	(-8.2)-102.2	331
308	coastal rainbow trout	0.0	0	0
	brown trout	856.3	663.6-1048.9	7304
	brook trout	401.5	212.4-590.7	3425
Average	coastal rainbow trout	10.7	n/a	77
	brown trout	1029.7	n/a	7797
	brook trout	151.2	n/a	1264

Discussion:

Yellow Creek in the vicinity of Humbug Valley is a brown trout-dominated fishery with coastal rainbow and brook trout occurring in considerably lower numbers. Coastal rainbow trout were captured only in the southern end of the meadow (Sections 108 and 208) and were found in low numbers and small sizes (the largest coastal rainbow trout captured was 6.5 inches). Brook trout were captured throughout the valley with densities increasing towards the upper end of the meadow (Section 308).

The Lincoln-Peterson mark-recapture method is a useful and popular method of estimating abundance. However, this model may produce misleading results if the assumptions are violated (Rosenberger 2005). Due to the high density of aquatic vegetation and deeply undercut banks, we were unable to install block nets to effectively close the population. During the evaluation of fish movement following completion of pass 2 we noted that in every section, marked fish were captured upstream and outside of the section boundaries. Therefore, the closed population assumption was violated. In addition, there may have been immigration into the section during the survey effort (i.e. between Pass 1 and 2); however, we were unable to specifically test for this. During the pass 2 effort in Section 208, we captured two fish that had been marked in Section 108. Section 108 was located approximately one-half mile downstream of Section 208. This

shows that fish movement occurs in Yellow Creek and, although we do not know whether these two fish moved prior to or during the survey effort in Section 208, we do know that within a 36-hour time period, they moved upstream approximately one-half mile.

Mesa and Schreck showed that electrofishing can alter fish behavior for up to 24 hours (1989). An inadequate recovery period may violate the assumption of equal probability of capture among marked and unmarked fish. Pass 1 and 2 were conducted approximately 12 hours apart; this timing may be inadequate for recovery.

Although we violated two of the assumptions of the Lincoln-Peterson method and our estimates may be biased, the electrofishing effort provided important information about species composition and size class structure of trout in Yellow Creek. In addition, it was useful to experiment with the use of an "electric fence" and test its efficacy.

If future goals and objectives are to quantify population densities of trout in Yellow Creek, HWTP staff recommends experimenting with block nets or some other technique to effectively close the population for the duration of the survey. This would allow the use of multiple pass depletion methods and provide more reliable population density estimates. In addition, the HWTP recommends increasing the sampling area to include the entire Wild Trout-designated area from the confluence with the North Fork Feather River upstream to, and including, Humbug Meadow. This will likely require the use of direct observation (snorkel survey) methods, as the portion of Yellow Creek between Humbug Valley and the confluence with the North Fork Feather River is in a remote canyon with limited access.

References:

Behnke, Robert. 2002. Trout and Salmon of North America. Chanticleer Press, Inc. NY.

Flosi, Gary; S. Downie; J. Hopelain, et al. 1998. California Salmonid Stream Habitat Restoration Manual. State of California Resources Agency. 3rd Edition. Department of Fish and Game. Vol 1.

Mesa, M.G. and C.B. Schreck. 1989. Electrofishing Mark-Recapture and Depletion Methodologies Evoke Behavioral and Physiological Changes in Cutthroat Trout. Transactions of the American Fisheries Society; 118:644-658.

Rosenberger, A.E. and J. Unham. 2005. Validation of Abundance Estimates from Mark-Recapture and removal techniques for Rainbow Trout Captured by Electrofishing in Small Streams. North American Journal of Fisheries Management; 25:1395-1410.

Rosgen, D.L., 1994. A Classification of Natural Rivers. Catena Vol 22 169-199.

White, Gary C. 1996. Noremark Reference Manual. Department of Fsihery and Wildlife. Colorado State University.