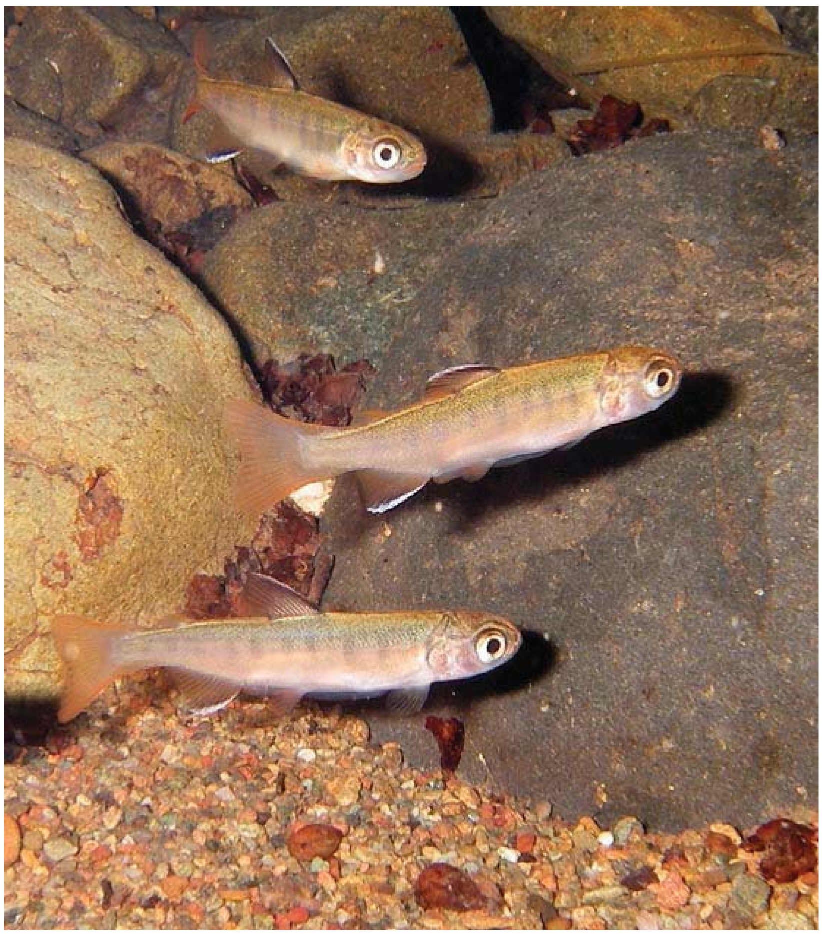
Russian River Coho Salmon Captive Broodstock Program
Monitoring Activities
Annual Report

July 2007 to June 2008



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INTRODUCTION

RUSSIAN RIVER COHO SALMON CAPTIVE BROODSTOCK PROGRAM

To aid in the effort to recover coho salmon in the state and federally-endangered Central California Coast Coho Salmon ESU, CDFG, NMFS, and the USACE initiated the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP) in 2001 with the goal of reestablishing self-sustaining runs of coho salmon in tributary streams within the Russian River basin. Under this program, offspring of wild, captive-reared coho are stocked as juveniles into tributaries within their historic range. These fish are released during different seasons (spring and fall) and into multiple historic tributaries within the Russian River drainage. A summary of coho releases from Warm Springs Hatchery from 2004 through 2007 is provided in **Table 1**.

Table 1. Number of coho released into Russian River tributaries in spring and fall, 2004-2007 (Louise Conrad, unpublished data).

	2004		2005		2006		2007	
Tributary	***Spring***	***Fall***	***Spring***	***Fall***	***Spring***	***Fall***	***Spring***	***Fall***
Mill	0	3,433	0	4,399	5,297	6,302	8,038	25,154
Palmer	0	0	2,466	1,920	2,102	3,021	3,967	3,880
Sheephouse	0	952	7,024	1,070	2,911	978	3,004	0
Ward	0	1,775	0	4,356	5,690	0	0	0
Gray	0	0	2,584	2,240	3,201	3,772	2,995	5,584
Gilliam	0	0	0	0	0	0	0	2,709
Green Valley	0	0	0	0	0	4,278	0	7,883
Dutch Bill	0	0	0	0	0	5,286	0	7,945
Seasonal Totals:	***0***	***6,160***	***12,074***	***13,985***	***19,201***	***23,637***	***18,004***	***53,155***
Annual Totals:	***6,160***		***26,059***		***42,838***		***71,159***	

Monitoring Component of RRCSCBP

The University of California Cooperative Extension (UCCE) and California Sea Grant Extension Program have worked with agency partners to develop and implement a monitoring and evaluation component for the RRCSCBP. The overall monitoring goal is to evaluate the effectiveness of the RRCSCBP by documenting whether released program fish return to their streams of release as adults and successfully complete their life cycles. Different hatchery release protocols and stocking environments are assessed to determine the optimal stocking strategies for successfully restoring coho to the Russian River system. Specific monitoring objectives for each release stream include: estimating seasonal instream abundance, comparing seasonal survival rates of spring and fall-released coho, estimating the number of returning adults, estimating juvenile to adult survival rates, measuring coho size and condition, estimating food availability, and documenting baseline flow and temperature regimes. All of these biotic and abiotic metrics are compared among the different program streams. This information will allow agencies to make informed decisions about the future direction of the program and adaptively manage release strategies for optimal survival. Results from monitoring efforts are routinely reported at Monitoring and Evaluation Committee (M&E Committee) meetings. The M&E Committee (representing county, state, and federal agencies, non-governmental organizations, and public and private parties), in turn, provides feedback and suggestions about how to improve the monitoring program and the RRCSCBP in general.

2007-2008 Statement of Goals and Objectives

Our primary goal for 2007-2008 was to compare seasonal survival and growth rates among groups of juvenile coho stocked into Mill, Palmer, Sheephouse, Gray, Gilliam, Green Valley, and Dutch Bill Creeks during different seasons (spring and/or fall after hatching). We also aimed to collect temperature, flow, and macroinvertebrate abundance data that may help explain any observed variation in coho growth and survival rates.

Specific objectives included:

1) Estimate late summer abundance and oversummer apparent survival of juvenile coho stocked into Russian River tributaries during the spring of 2007.
2) Estimate the number, migration timing, and size of adult coho returning to program streams during the winter of 2007 to 2008
3) Estimate the number, migration timing, size, and condition factor of coho smolts emigrating from stocked tributaries.
4) Estimate instream overwinter apparent survival of coho that were released during the spring and fall of 2007.
5) Compare instream overwinter apparent survival, size and condition factor between spring and fall-released coho.
6) Conduct snorkeling surveys in program tributaries to determine presence/absence of juvenile coho.
7) Compare macroinvertebrate abundance among program streams as a measure of food availability for stocked coho.
8) Record continuous temperature and flow data on selected program streams.

Report Purpose and Time Frame

The purpose of this document is to satisfy the reporting requirements outlined in CDFG Contract P0630024 and NMFS Permit 1067 issued to CDFG under the authority of Section 10 of the Endangered Species Act. Monitoring activities were carried out on the seven streams that were stocked in 2007 (Mill, Palmer, Sheephouse, Gray, Gilliam, Green Valley, and Dutch Bill Creeks), in Felta and Wallace Creeks which were not stocked but lie within the Mill Creek system, and in Ward Creek which was stocked in previous years (2004-2006) (**Figure 1**). Data collected from July 1, 2007 through June 30, 2008 are summarized in this report and cover the instream portion of the life cycle from summer after (spring) stocking through smolt migration.

Additionally, this report is intended to compile and compare previous years' monitoring results, beginning with UCCE's initial coho monitoring activities in 2004. Accordingly, the tables and figures have been formatted to provide summary data from 2004 through the 2007-2008 reporting year. Previous annual reports (Conrad 2005, Conrad et al. 2006, Obedzinski et. al. 2007, Obedzinski et. al. 2008) present details of the monitoring activities that generated the earlier results compiled in this report.

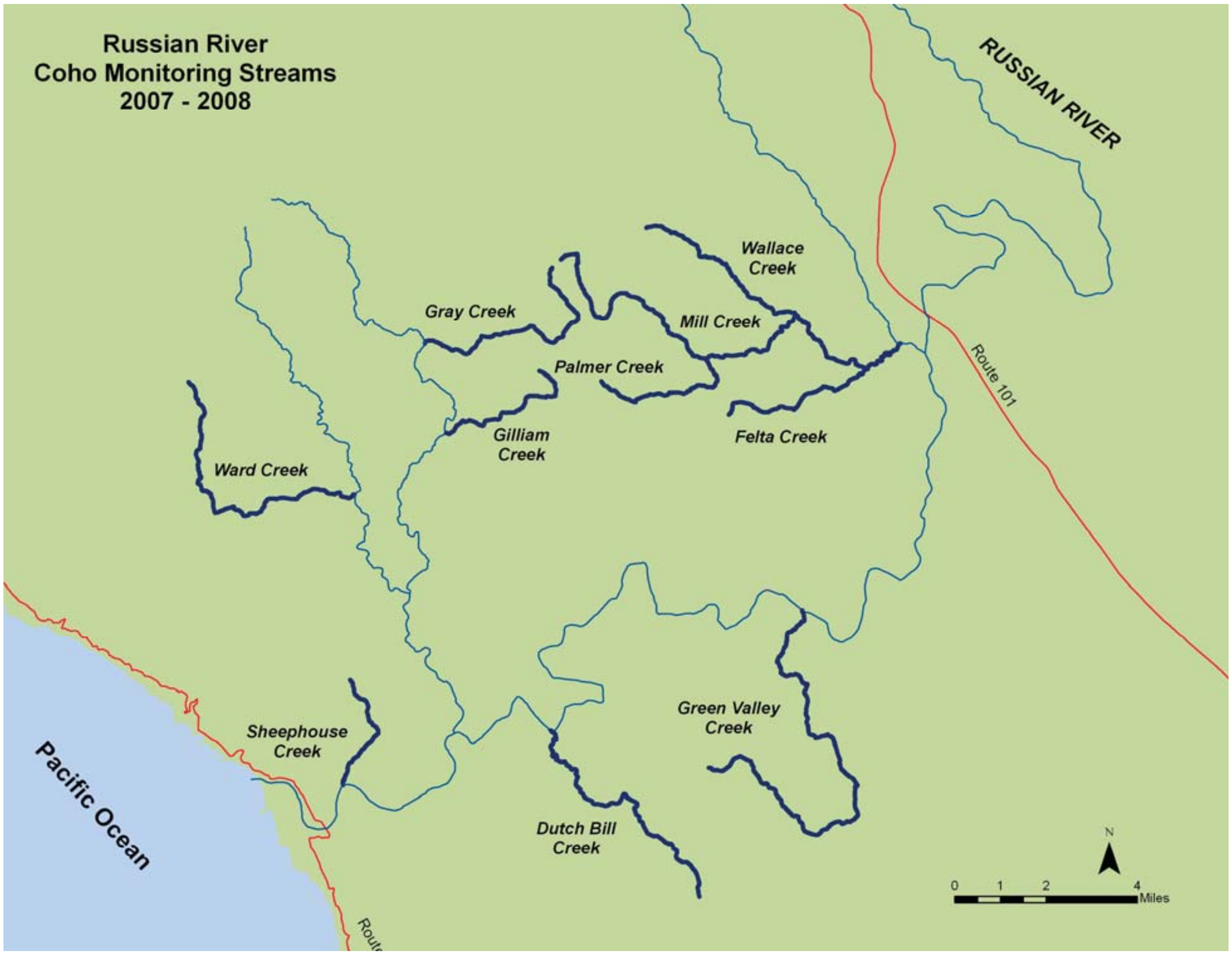

Figure 1. Map of Russian River coho program streams monitored in 2007-2008.

DATA COLLECTION AND ANALYSIS

OVERSUMMER SURVIVAL ESTIMATES

Data was collected during the summer of 2007 to estimate late summer abundance and oversummer survival of coho released from Warm Springs Hatchery into Mill, Palmer, Sheephouse, and Gray Creeks during the spring of 2007. In addition, we collected data on fish size and condition in the four release streams.

Methods

Population estimates using the basinwide visual estimation technique (BVET) (Dolloff et. al. 1993) were conducted on the four spring release streams to estimate population size at the end of summer (August – September) 2007. These estimates were then compared to the number of fish released into each creek during the spring to estimate oversummer survival of released coho in each creek. Following the BVET sampling design (Dolloff et. al 1993) and CDFG sampling methodology (CDFG 2003), we collected data for the population estimate in three parts:

1. Habitat surveys: Sampling reaches on each tributary extended from the mouth of the tributary (Palmer, Sheephouse and Gray) or from 2 km upstream of the mouth (Mill) upstream to a known migration barrier for juvenile coho. Surveyors walked each reach from downstream to upstream classifying habitat units as pools, glides, riffles, or dry. Each habitat unit was measured for length, maximum depth, and dominant substrate types. Width and average depth were estimated in each habitat unit and a subset of these (a minimum of 20%) were measured for calibration of visual estimates. An average calibration ratio of measured and estimated values was then used to adjust widths and depths of units that were only estimated. Pools were additionally given a qualitative instream cover rating and the percentage of the pool with instream cover was visually estimated.

2. Snorkeling counts: For shorter streams (Palmer, Sheephouse and Gray) approximately every other pool and glide in each tributary was snorkeled, and for longer streams (Mill), approximately every third pool and glide was snorkeled. Depending on pool size, either one or two divers counted the number of coho yoy in each habitat unit by carefully snorkeling from downstream to upstream. Presence or absence of steelhead yoy, steelhead parr (≥ age 1+), and other fish species was also recorded.

3. Electrofishing surveys: A proportion of the pools and glides that were snorkeled were also electrofished using a multiple-pass removal method (White et. al. 1982). Program MARK (White and Burnham 1999) was used to estimate the total number of coho yoy, steelhead yoy, and steelhead parr in each electrofished habitat unit. A calibration ratio between the number of coho observed diving and the number estimated based on electrofishing was calculated to adjust the dive counts. Additionally, a small proportion of the riffle habitat was electrofished but not snorkeled due to shallow water depth.

Average coho densities for pools and glides were estimated using the calibrated dive counts. Average densities were then multiplied by the total available habitat area (based on habitat surveys) for each habitat type, and summed over habitat type, resulting in an abundance estimate for the entire stream reach. Resulting abundance estimates were then compared to the number of fish stocked the previous spring to estimate oversummer apparent survival rates.

During the 2007 spring release, approximately 3,000 PIT tagged coho were released into five reaches of Mill and Palmer Creeks; 750 PIT tagged fish into each of two 375m reaches on Palmer Creek, and 500 PIT tagged fish into each of three 250m reaches on Mill Creek (**Figure 2**). Stationary PIT tag detection systems (antennas and transceivers) were operated at the mouth of Palmer Creek and 2 km above the mouth of Mill Creek at the downstream migrant trap site. These detection systems were used to document movement to and from Mill and Palmer Creeks by recording the PIT tag number and detection time for each PIT tagged fish that swam through the antennas. Data collected at the PIT tag detection stations were used to quantify the number of PIT tagged fish that moved to and from Mill and Palmer Creeks between the spring release and the beginning of BVET data collection. The proportion of PIT tagged to non-PIT tagged fish stocked was used to estimate the total number of fish that moved to and from each tributary. Net immigration or emigration from each stream was then added or subtracted to the original number of fish stocked in each stream. This adjusted stocking number was then used for calculating estimates of survival. For comparison among streams and years, the unadjusted stocking number was used to calculate estimates of "apparent" survival (confounded probability of fidelity and survival), because that is what we estimated in years prior to operation of PIT tag detection systems, and on streams with no PIT tag data. Apparent and adjusted survival are reported in the results for Mill and Palmer Creeks.

Because the interval between spring stocking and completion of the BVET surveys differed between streams, daily survival rates were calculated and then expanded to a four month interval between June 15 and October 15; the approximate time of spring stocking until the first rain of the season and fall release. This allowed for comparison among streams and years, however, it assumes that the daily summer survival rate in a given stream did not vary over the four month period.

In addition to collecting data for abundance estimates, the electrofishing samples allowed us to collect data on size and condition of salmonids. In each electrofished habitat unit, subsamples of up to 20 coho and steelhead were anesthetized and measured for fork length (+/- 1mm) and weight (+/- 0.1 g). Each coho was checked for presence of an adipose fin to determine whether the fish was of wild (intact adipose fin) or hatchery (clipped adipose fin) origin, and scanned with a CWT wand to determine CWT location, an indicator of release tributary. On Mill and Palmer Creeks, each coho was also scanned with a PIT tag wand to determine presence and number of a PIT tag. All other fish and non-fish species were quantified.

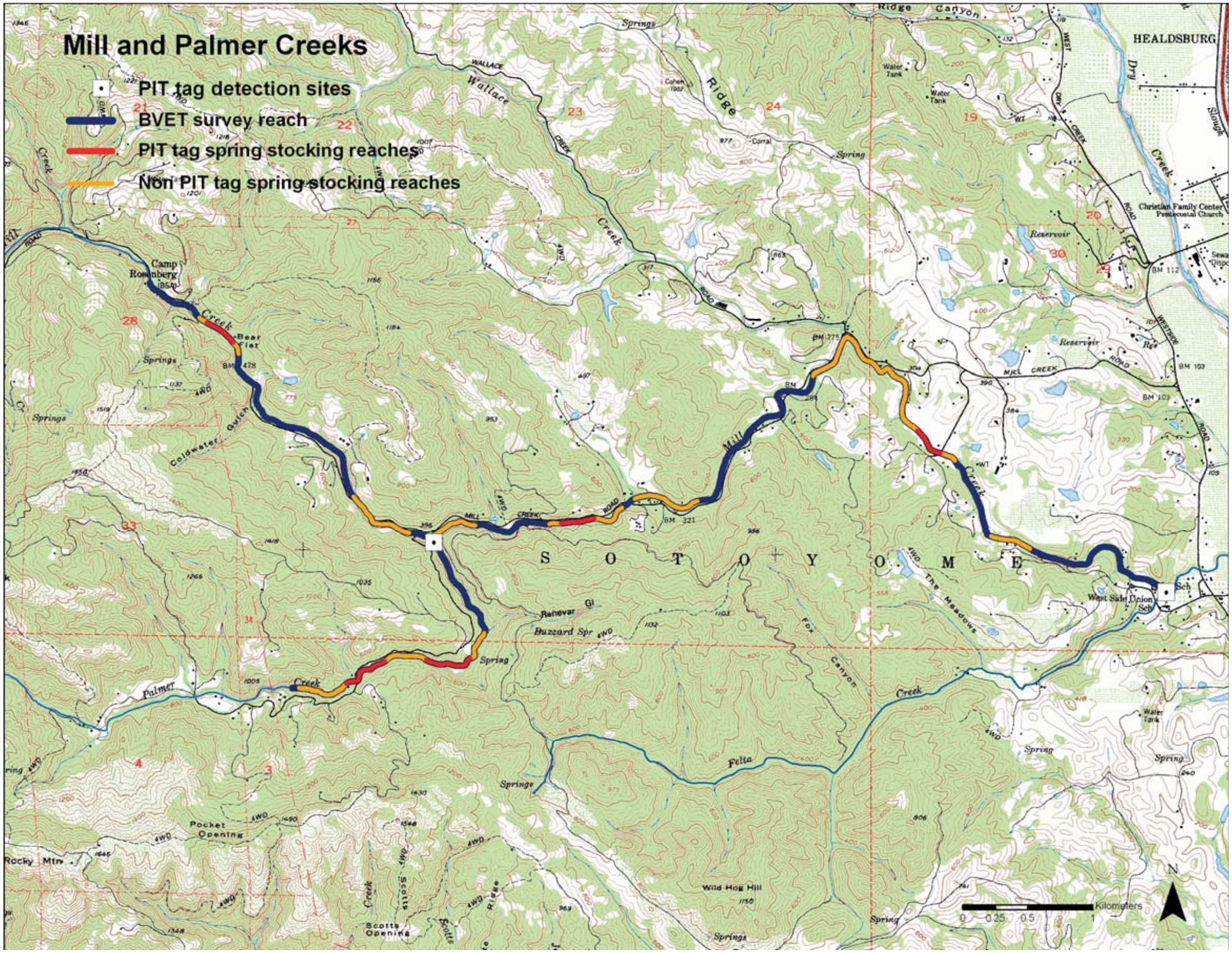

Figure 2. Map of spring stocking and summer BVET survey reaches on Mill and Palmer Creeks, 2007.

Results

BVET surveys

BVET surveys were completed on Mill Creek (9/4-10/4), Palmer Creek (9/5-10/2), Sheephouse Creek (8/9-8/21), and Gray Creek (8/20-8/30). Survey reaches on each creek extended from our downstream migrant trap site (Mill) or the mouth of the stream (all other creeks) to an upstream migration barrier above the uppermost stocking site (**Figure 2-4**). In order to confirm that coho were not able to swim over the barrier, 10 to 15 pools above each barrier were snorkeled, and no coho were observed.

Wetted reach length ranged from 1.0 km on Sheephouse Creek to 9.6 km on Mill Creek. In Mill and Sheephouse Creeks, this represented a significant reduction in wetted reach length from the previous summer (**Table 2**). On Sheephouse Creek, wetted reach length during the BVET survey was higher than reported in **Table 2**, however, a follow-up survey conducted on 9/6 found extreme reductions in wetted habitat, and this value (**Table 2**) was used for oversummer survival estimates.

In 2007, total wetted area was lower in all streams compared to previous years, and was particularly extreme in Sheephouse Creek. Decreases in wetted area were more prevalent in glide and riffle habitat than pool habitat (**Table 2**). Much of the riffle and shallow glide habitat available in previous years was dry in 2007.

In smaller streams (Palmer, Sheephouse and Gray Creeks) 44-51% of pool units and 47-52% of glide units were snorkeled, and in Mill Creek 34% of pool units and 30% of glide units were snorkeled (**Table 3**). Additionally, in smaller streams 15-49% of pool units, 16-38% of glide units, and 6-18% of riffle units were electrofished, and in Mill Creek 9% of pools, 10% of glides, and 4% of riffles were electrofished (**Table 3**). Riffles were too shallow to snorkel so we relied entirely on electrofishing estimates to determine average coho densities in riffle habitat.

Calibration ratios (electrofishing estimate/dive count) used to adjust the dive counts varied by stream, habitat type and year (**Table 4**). In 2007, ratios ranged from 0.96 to 1.34 in pool units and from 1.50 to 2.95 in glide units, and were within the range of values observed in previous years. High calibration ratios (>2) in glides are likely explained by the difficulty of counting fish in the extremely shallow conditions during low flow years. Calibration ratios less than one indicate that fish were either double counted (which often occurs in larger pools) or that the assumption of no mortality or emigration between snorkeling and electrofishing samples was violated.

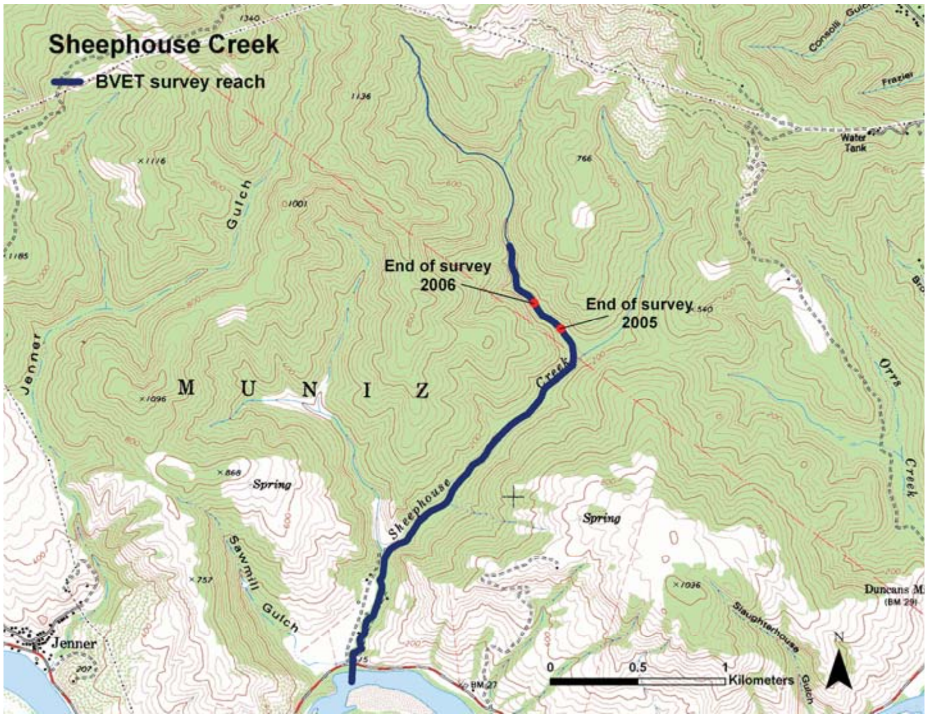

Figure 3. Map of summer BVET survey reaches on Sheephouse Creek, 2007.

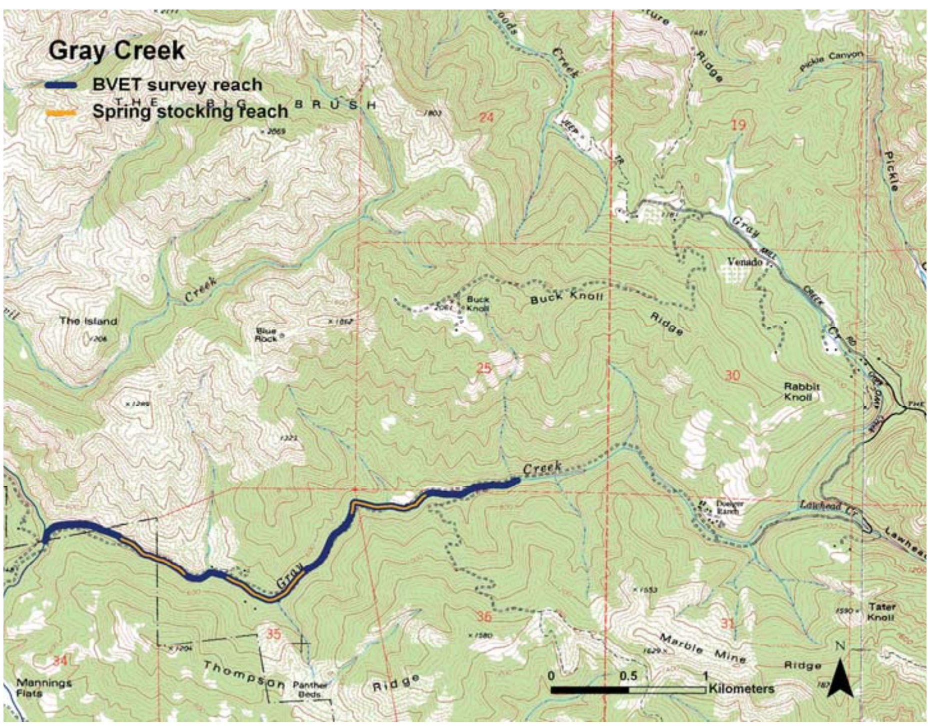

Figure 4. Map of spring stocking and summer BVET survey reaches on Gray Creek, 2007.

Table 2. Habitat characteristics of stream reaches sampled for BVET estimates, 2005-2007.

Year	Tributary	Survey dates	Wetted reach length (km)	Total reach length (km)	Wetted area (m^2)				Percent of total		
					Pools	Glides	Riffles	Total	Pools	Glides	Riffles
2005	Palmer	8/8 - 8/10	2.9	2.9	3,963 +/- 0	1,339 +/- 0	4,057 +/- 50	9,359 +/- 87	42	14	43
2005	Sheephouse	9/1 - 9/7	3.1	3.1	4,898 +/- 19	1,620 +/- 0	1,760 +/-16	8,278 +/- 42	59	20	21
2005	Gray	9/20 - 9/22	4.0	4.0	5,895 +/-0	2,062 +/-0	4,628 +/- 0	12,585 +/-0	47	16	37
2006	Mill	8/8 - 8/21	12.9	12.9	36,134 +/- 1,235	10,299 +/- 600	14,794 +/- 488	61,227 +/- 2,502	59	17	24
2006	Palmer	9/11 - 9/14	2.6	2.6	3,894 +/- 13	1,337 +/- 0	2,779 +/- 32	8,010 +/- 59	49	17	35
2006	Sheephouse	9/12 - 9/14	3.1	3.4	3,366 +/- 26	2,557 +/- 0	731 +/- 0	6,654 +/- 45	51	38	11
2006	Ward	8/7 - 8/16	6.5	6.5	13,648 +/- 784	7,738 +/- 589	6,057 +/- 463	27,443 +/- 1,853	50	28	22
2006	Gray	9/25 - 10/2	4.1	4.1	4,524 +/- 0	3,995 +/- 14	3,704 +/- 17	12,222 +/- 37	37	33	30
2007	Mill	9/4 - 9/13	9.6	12.8	23,103 +/- 55	5,367 +/- 203	6,836 +/- 201	35,306 +/- 498	65	15	19
2007	Palmer	9/5 - 9/26	2.9	3.0	4,324 +/-0	1,274 +/- 5	1,577 +/- 14	7,175 +/- 25	60	18	22
2007	Sheephouse	8/9 - 8/15, 9/6	1.0	2.7	940 +/- 5	444 +/- 0	432 +/- 0	1,815 +/- 9	52	24	24
2007	Gray	8/20 - 8/28	4.2	4.2	7,133 +/- 13	1,541 +/- 0	2,032 +/- 212	10,075 +/- 367	67	14	19

Table 3. Percentage and number of pools, glides and riffles sampled using snorkeling (SN) or electrofishing (EF) methods each summer from 2005-2008. Riffles were not snorkeled due to shallow depths.

		Pools			Glides			Riffles		
Year	**Tributary**	**Total units**	**%SN (n)**	**%EF (n)**	**Total units**	**%SN (n)**	**%EF (n)**	**Total units**	**%SN (n)**	**%EF (n)**
2005	Palmer	72	50 (36)	18 (13)	31	32 (10)	32 (10)	75	0	7 (5)
2005	Sheephouse	109	50 (55)	18 (20)	45	22 (10)	22 (10)	76	0	7 (5)
2005	Gray	95	49 (47)	16 (15)	50	32 (16)	16 (8)	105	0	8 (8)
2006	Mill	265	20 (54)	6 (16)	100	19 (19)	10 (10)	225	0	4 (9)
2006	Palmer	77	52 (40)	18 (14)	40	48 (19)	25 (10)	83	0	12 (10)
2006	Sheephouse	95	52 (49)	18 (17)	94	36 (34)	11 (10)	57	0	14 (8)
2006	Ward	134	24 (32)	12 (16)	114	24 (27)	9 (10)	126	0	8 (10)
2006	Gray	74	53 (39)	19 (14)	119	47 (56)	12 (14)	122	0	8 (10)
2007	Mill	244	34 (84)	9 (21)	105	30 (31)	10 (11)	174	0	4 (7)
2007	Palmer	106	44 (47)	25 (26)	67	52 (35)	22 (15)	92	0	10 (9)
2007	Sheephouse	47	47 (22)	49 (23)	34	47 (16)	38 (13)	33	0	18 (6)
2007	Gray	174	51 (89)	15 (26)	94	49 (46)	16 (15)	147	0	6 (9)

Table 4. Calibration ratios (electrofishing estimates/snorkeling counts) of pool (P) and glide (G) units sampled during BVET surveys, 2005-2008.

		# Calibration units		Calibration ratio (R^2)	
Year	**Tributary**	**P**	**G**	**P**	**G**
2005	Palmer	13	10	1.13 (0.91)	1.81 (0.99)
2005	Sheephouse	20	10	1.36 (0.82)	1.32 (0.81)
2005	Gray	15	8	1.30 (0.85)	1.72 (0.97)
2006	Mill	16	10	0.84 (0.85)	1.25 (0.82)
2006	Palmer	14	10	1.46 (0.80)	3.31 (0.42)
2006	Sheephouse	16	10	1.49 (0.93)	1.98 (0.62)
2006	Ward	16	9	1.40 (0.55)	1.77 (0.44)
2006	Gray	14	14	0.92 (0.67)	1.40 (0.96)
2007	Mill	19	11	1.18 (0.76)	1.80 (0.86)
2007	Palmer	26	15	1.34 (0.80)	2.15 (0.92)
2007	Sheephouse	19	12	1.29 (0.87)	2.95 (0.58)
2007	Gray	26	15	0.96 (0.94)	1.50 (0.64)

Oversummer movement and survival

Following the spring release in 2007, the majority of fish movement to and from Mill and Palmer Creeks occurred during the first two days following stocking and a greater number of fish were observed leaving Palmer and entering Mill than vice versa (**Figure** 5). A total of 444 PIT tagged fish were detected leaving Palmer Creek and 18 were detected at the Mill antenna, presumably leaving the Mill system. All except three fish that left Palmer remained in Mill, and there was very little emigration from Mill Creek from any release group. Extremely low summer flows likely prohibited movement after mid-June. Adjustments to the number of fish stocked based on movement data increased the net number of fish stocked into Mill Creek and decreased the net number stocked into Palmer Creek (**Figure 6**). This is reflected in the difference between apparent verses adjusted survival in each stream (**Table 5**). Apparent survival of spring released coho in 2007 ranged from 0.18 in Sheephouse Creek to 0.36 in Gray Creek (**Table 5**). In all but Mill Creek, survival estimates were equal to or lower than those in previous years (**Table 5**, **Figure 7**). Within the Mill Creek watershed, estimates of survival in Palmer Creek were higher than in Mill Creek in both 2006 and 2007.

In Sheephouse Creek, the survival estimate in 2007 was much lower than in previous years, and we suspect this was related to extremely low flows in September that caused all but 1.0 km of the stream to dry up. The oversummer survival rate estimated from the BVET data collected in late August was 0.57 (0.41-0.76), similar to estimates from previous years. However, on 9/6/07, a survey in Sheephouse revealed that approximately three-fourths of the stream had dried. At the time of the BVET survey, almost all pools were intermittent. We therefore assumed that all fish inhabiting pools that were dry on 9/6 had perished and adjusted our estimates of survival to incorporate this extreme mortality event.

The higher estimate of survival in Mill Creek in 2007 compared to 2006 may be related to stream temperature. Average temperatures were higher in 2006 than in 2007 (see Temperature section), and these differences were more pronounced in Mill Creek than in other streams, which could explain the lower survival in 2006. Variation in flow may have also played a role. Although higher summer flows likely increase survival, higher flows also allow for increased summer movement which can influence apparent survival estimates. In 2006, summer flows were higher than in 2007, as evidenced by the higher amount of wetted area (**Table 2**). Although we could not quantify emigration from Mill Creek in 2006, we did find evidence, through capture in the downstream migrant trap, that hatchery released fish were emigrating from Mill in the days immediately following the release (Obedzinski et. al. 2007). This may have had the effect of reducing estimates of apparent survival in 2006. In 2007, flows were lower at the time of release and few fish were observed emigrating from Mill Creek immediately following the spring release, which may have had the effect of increasing estimates of apparent survival (**Figure 55**).

In general, estimates of oversummer survival in Palmer, Sheephouse and Gray Creeks are only slightly lower than estimates in pristine streams with wild coho populations in Northern California (Brakensiek 2002) and Oregon (Kruzic et. al. 2001). Oversummer survival estimates during certain years on Mill, Sheephouse and Ward Creeks, however, are relatively low (**Table 5, Figure 7**).

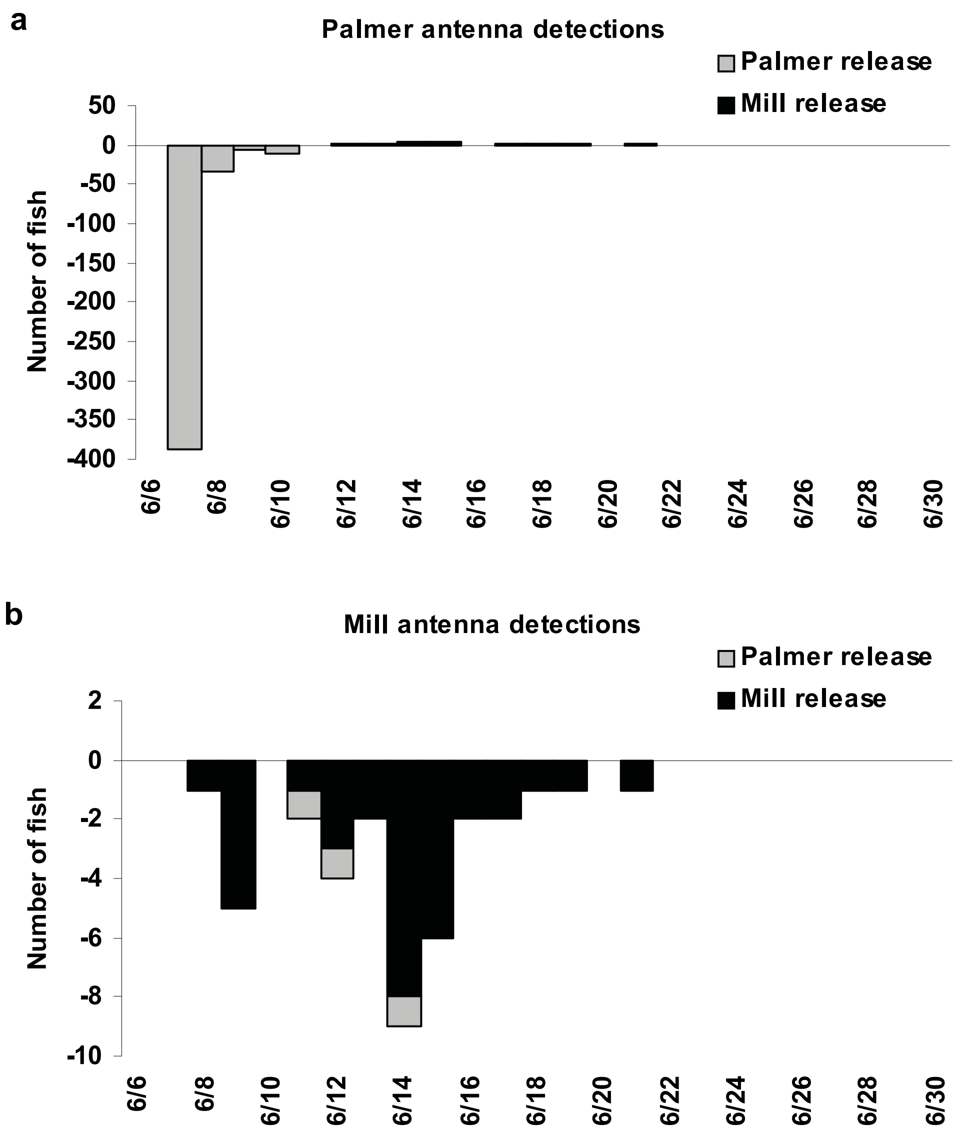

Figure 5. Number of unique PIT tagged fish detected at the Palmer Creek antenna (a) and Mill Creek antenna (b) after the release of PIT tagged fish into Palmer (6/6) and Mill (6/7)**.** Negative values represent downstream movements and positive values represent upstream movements. Note differences in y-axis scale. No detections were observed on either antenna between 6/29 and the beginning of BVET surveys on 9/4.

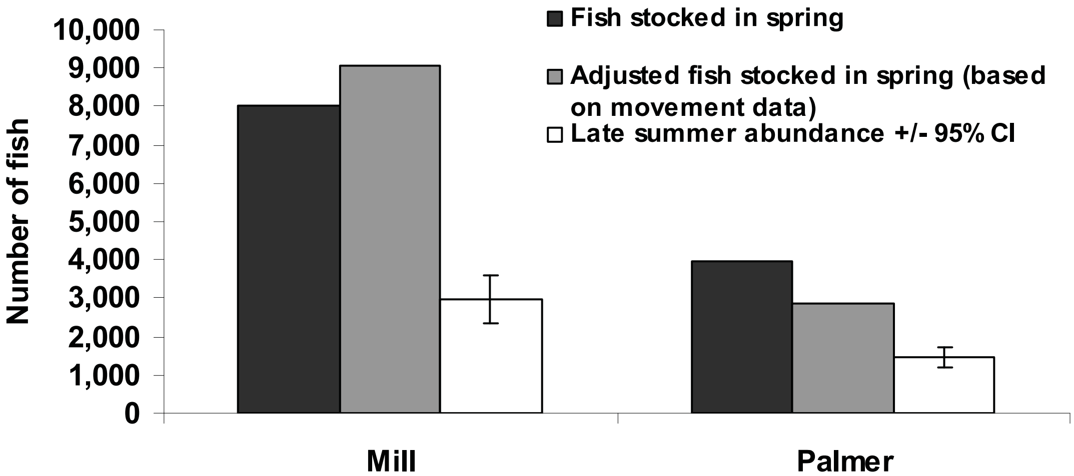

Figure 6. Number of spring released coho, adjusted number of spring released coho based on movement data collected at PIT tag detection sites, and late summer abundance estimates for Mill and Palmer Creeks in 2007.

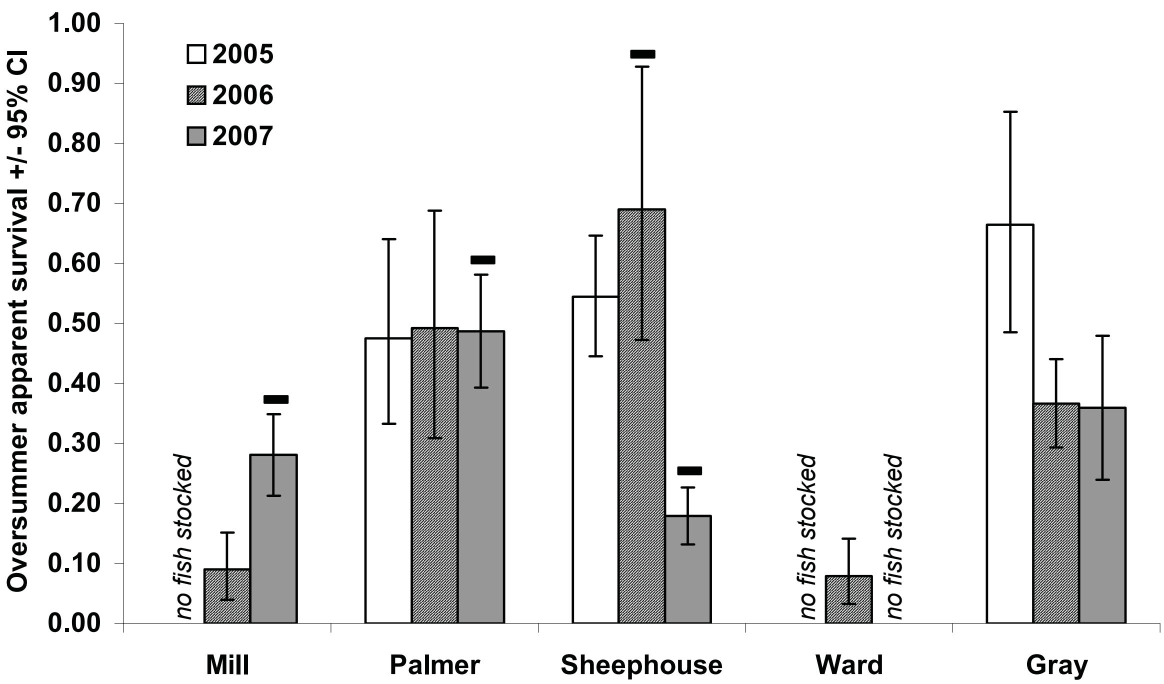

Figure 7. Oversummer apparent or adjusted survival (June 15 - October 15) of spring released juvenile coho stocked each year into Russian River tributaries, 2005 through 2007. Black bars indicate estimates that accounted for fish movement; in Mill and Palmer adjustments were made using PIT tag data, and in Sheephouse movement from the stream was prevented by closure of the mouth prior to spring stocking.

Table 5. Estimated oversummer abundance, apparent survival, and adjusted survival of spring released juvenile coho stocked into Russian River tributaries annually from 2005-2007.

Year	Tributary	Number stocked	Stock date range	Electrofishing sample date range	Abundance (95%CI)	Apparent survival (95% CI)[1]	Adjusted survival (95% CI)[2]
2005	Palmer	2,466	06/09 - 06/09	08/16 - 08/18	1,620 (1,322 -1,917)	0.48 (0.33 - 0.64)	*na*
2005	Sheephouse	7,024	05/31 - 05/31	09/08 - 09/15	4,193 (3,537- 4,850)	0.54 (0.45 - 0.65)	*na*
2005	Gray	2,584	06/21 - 06/21	09/28 - 10/03	1,839 (1,415 - 2,263)	0.66 (0.48 - 0.85)	*na*
2006	Mill	5,297	06/13 - 06/14	08/31 - 09/12	997 (562 - 1,432)	0.09 (0.04 - 0.15)	*na*
2006	Palmer	2,102	06/12 - 06/12	09/15 - 09/26	1,172 (799 - 1,544)	0.49 (0.31 - 0.69)	*na*
2006	Sheephouse	2,911	06/21 - 06/21	09/18 - 09/25	2,199 (1,648 - 2,749)	0.69 (0.47 - 0.93)	0.69 (0.47 - 0.93)
2006	Ward	5,690	06/19 - 06/20	08/22 - 08/30	1,395 (863 - 1,926)	0.08 (0.03 - 0.14)	*na*
2006	Gray	3,201	06/15 - 06/15	09/28 - 10/05	1,310 (1,076 - 1,544)	0.37 (0.29 - 0.44)	*na*
2007	Mill	8,038	06/07 - 06/08	09/12 - 10/04	2,953 (2,332 - 3,573)	0.32 (0.25 - 0.40)	0.28 (0.21 - 0.35)
2007	Palmer	3,967	06/06 - 06/06	09/24 - 10/02	1,469 (1,205 - 1,733)	0.35 (0.28 - 0.41)	0.49 (0.39 - 0.58)
2007	Sheephouse	3,004	06/04 - 06/04	08/14 - 08/21	1,053 (890 - 1,215)	0.18 (0.14 - 0.23) [3]	0.18 (0.14 - 0.23) [3]
2007	Gray	2,995	06/05 - 06/05	08/22 - 08/30	1,506 (1,186 - 1,826)	0.36 (0.25 - 0.48)	*na*

[1] To account for different time intervals between stocking and summer sampling among streams, apparent survival estimates were adjusted to represent a four month period (June 15 - October 15).

[2] In Mill and Palmer Creeks, adjusted survival was calculated by incorporating movement information into abundance estimates using PIT tagged fish and PIT tag detection systems (e.g. 0.49 is an oversummer survival estimate for fish that remained in Palmer Creek between June 15 and October 15). In Sheephouse Creek, mouth closure prior to spring stocking 2006 and 2007 prevented movement from the stream during the summer, therefore apparent and adjusted survival estimates were the same in those years.

[3] Based on a BVET survey conducted Aug 14 - Aug 21, 2007, oversummer apparent survival on Sheephouse was 0.57 (0.41 - 0.76). However, by 9/6/07, only 1 km of wetted stream remained. The oversummer apparent survival estimate was adjusted to incorporate this extreme mortality event.

Summer densities

As in previous years, coho densities were generally higher in pool habitat compared with glide habitat (**Table 6**). In 2007, densities in pool habitat increased from densities in 2006. In Palmer Creek, this is presumably due to lower flow conditions since similar numbers of fish were stocked during the spring of each year. Glide densities remained similar to those in previous years. Overall densities have remained highest in Sheephouse Creek, and Palmer Creek densities have remained higher than those in Mill Creek.

Table 6. Average annual summer coho yoy densities in pool, riffle, and glide habitat in Russian River tributaries stocked each spring from 2005 to 2007.

Year	Tributary	BVET sample date range	Fish/m^2 pools (95%CI)	Fish/m^2 glides (95%CI)	Fish/m^2 riffles (95%CI)
2005	Palmer	8/8 - 8/18	0.37 (0.24 - 0.50)	0.17 (0.00 - 0.34)	0.01 (0.00 - 0.03)
2005	Sheephouse	9/1 - 9/15	0.76 (0.63 - 0.88)	0.45 (0.31 - 0.60)	0.06 (0.01 - 0.11)
2005	Gray	9/20 - 10/3	0.31 (0.16 - 0.46)	0.10 (0.03 - 0.18)	0.02 (0.00 - 0.03)
2006	Mill	8/8 - 9/12	0.04 (0.02 - 0.05)	0.01 (0.00 - 0.02)	0.00 (0.00 - 0.01)
2006	Palmer	9/11 - 9/26	0.23 (0.17 - 0.29)	0.14 (0.06 - 0.22)	0.01 (0.00 - 0.02)
2006	Sheephouse	9/12 - 9/25	0.43 (0.31 - 0.55)	0.45 (0.11 - 0.78)	0.03 (0.00 - 0.07)
2006	Ward	8/7 - 8/30	0.10 (0.06 - 0.14)	0.03 (0.02 - 0.05)	0.00 (0.00 - 0.00)
2006	Gray	8/20 - 10/5	0.24 (0.13 - 0.36)	0.08 (0.05 - 0.11)	0.00 (0.00 - 0.00)
2007	Mill	9/4 - 10/4	0.12 (0.09 - 0.14)	0.02 (0.01 - 0.04)	0.00 (0.00 - 0.00)
2007	Palmer	9/5 - 10/2	0.31 (0.25 - 0.36)	0.15 (0.10 - 0.21)	0.00 (0.00 - 0.00)
2007	Sheephouse	8/9 - 8/21	0.47 (0.34 - 0.59)	0.47 (0.19 - 0.74)	0.00 (0.00 - 0.00)
2007	Gray	8/20 - 8/30	0.16 (0.13 - 0.20)	0.05 (0.03 - 0.07)	0.02 (0.00 - 0.05)

Size and growth

Size at release during the spring of 2007 was similar to previous years (**Table 7**). Assuming no size-dependent emigration or mortality, stocked coho increased in average fork length and weight over the summer in all streams, with the exception of a slight decrease in weight for fish stocked into Gray Creek (**Table 7**). In contrast, average condition factor (K) was lower during the BVET samples than in the sample taken immediately prior to release.

In all streams except Sheephouse, daily specific growth rates for fork length and weight were lower in 2007 than in previous years (**Table 8**). Surprisingly, growth rates were highest in Sheephouse Creek, which also had the highest densities (**Table 6**). For the third year in a row, Gray Creek had the lowest estimates of growth. Predicted average sizes for October 15 (approximate time of fall release) were smaller than in previous years (**Table 8**).

Table 7. Average fork length (FL), weight (WT) and condition factor (K) of juvenile coho prior to release and during late summer BVET surveys, 2005 through 2007.

		Prestocking averages (95% CI)					BVET averages (95% CI)				
Year	**Trib**	**Sample date**	**n**	**FL (mm)**	**WT (g)**	**K**	**Sample date**	**n**	**FL (mm)**	**WT (g)**	**K**
2005	PAL	6/7	50	59.2 +/- 1.5	2.80 +/- 0.24	1.31 +/- 0.04	8/17	263	67.3 +/- 0.8	3.54 +/- 0.14	1.13 +/- 0.01
2005	SHE	5/18	100	57.0 +/- 1.4	2.53 +/- 0.21	1.29 +/- 0.04	9/11	637	69.1 +/- 0.6	3.86 +/- 0.11	1.12 +/- 0.01
2005	GRA	6/20	50	61.6 +/- 2.1	2.89 +/-0.31	1.18 +/- 0.03	9/30	235	70.9 +/- 1.0	4.10 +/- 0.16	1.12 +/- 0.01
2006	MIL	6/8	250	57.0 +/- 0.9	2.48 +/- 0.12	1.28 +/- 0.02	9/4	71	69.9 +/- 1.4	4.13 +/- 0.24	1.19 +/- 0.02
2006	PAL	6/8	100	56.9 +/- 1.6	2.77 +/- 0.24	1.42 +/- 0.03	9/20	235	64.9 +/- 0.8	3.19 +/- 0.13	1.13 +/- 0.02
2006	SHE	6/20	150	61.9 +/- 1.1	3.28 +/- 0.18	1.35 +/- 0.02	9/20	291	69.4 +/- 0.9	3.79 +/- 0.17	1.09 +/- 0.02
2006	WAR	6/16	250	61.7 +/- 0.9	3.14 +/- 0.14	1.29 +/- 0.02	8/27	134	68.4 +/- 1.0	3.68 +/- 0.16	1.13 +/- 0.02
2006	GRA	6/14	150	61.8 +/- 1.0	3.16 +/- 0.15	1.30 +/- 0.02	9/30	176	67.4 +/- 0.8	3.22 +/- 0.14	1.03 +/- 0.02
2007	MIL	5/31	118	59.5 +/- 1.0	2.58 +/- 0.15	1.19 +/- 0.03	9/19	534	66.6 +/- 0.5	3.17 +/- 0.08	1.04 +/- 0.01
2007	PAL	5/28	157	60.1 +/- 0.8	2.67 +/- 0.12	1.20 +/- 0.02	9/27	706	64.9 +/- 0.5	2.86 +/- 0.08	1.00 +/-0.01
2007	SHE	6/1	50	56.8 +/- 1.3	2.27 +/- 0.16	1.22 +/- 0.03	8/17	327	63.8 +/- 0.8	2.97 +/- 0.12	1.10 +/- 0.01
2007	GRA	6/1	50	58.3 +/- 1.5	2.46 +/- 0.19	1.22 +/- 0.04	8/25	246	60.5 +/- 0.8	2.32 +/- 0.10	1.01 +/- 0.01

Table 8. Specific growth rates and predicted sizes for fork length (FL) and weight (WT) of juvenile coho stocked into Russian River tributaries, springs 2005 through 2007.

Year	Tributary	Interval dates for g	Daily specific growth rate (g)[1]		Predicted average size Oct 15 [2]	
			FL	WT	FL (mm)	WT (g)
2005	Palmer	6/7 - 8/17	0.1138	0.0033	74.0	4.29
2005	Sheephouse	5/18 - 9/11	0.1042	0.0036	72.6	4.37
2005	Gray	6/20 - 9/30	0.0910	0.0034	72.2	4.31
2006	Mill	6/8 - 9/6	0.1438	0.0057	75.5	5.16
2006	Palmer	6/8 - 9/20	0.0761	0.0013	66.8	3.29
2006	Sheephouse	6/20 - 9/21	0.0794	0.0015	71.2	3.93
2006	Ward	6/16 - 8/26	0.0926	0.0022	72.9	4.09
2006	Gray	6/14 - 10/1	0.0511	0.0002	68.0	3.23
2007	Mill	5/25 - 9/23	0.0591	0.0017	67.9	3.30
2007	Palmer	5/26 - 9/28	0.0388	0.0006	65.6	2.89
2007	Sheephouse	6/1 - 8/18	0.0894	0.0034	69.0	3.63
2007	Gray	6/1 - 8/26	0.0252	-0.0007	61.7	2.23

[1] Specific growth rate was calculated as $g = (\ln(W_2)-\ln(W_1))/t_2-t_1$ for weight and $g = (FL_2-FL_1)/t_2-t_1$ for fork length where W=average weight, FL= average fork length, and t=median date of sample.

[2] Predicted size was calculated as $W_p = W_1(\exp(g(t_2-t_1)))$ for weight and $FL_p = FL_1 + g(t_2-t_1)$ for fork length where W=average weight, FL=average fork length, g=specific growth rate, and t=date of sample or prediction.

Other species

In addition to program coho yoy, other fish and non-fish species were captured during the electrofishing portion of the BVET surveys (**Table 9**). The number of steelhead observed in Mill and Palmer Creeks was higher than in previous years, and in Sheephouse and Gray Creeks it was lower. The number of sculpin observed in Mill and Palmer Creeks was higher than in previous years, and in Sheephouse and Gray it was similar. Roach were observed only in Mill and Gray Creeks, and lamprey ammocoetes were only observed in Mill Creek. An increased number of California giant salamanders were observed in all streams except Palmer Creek. The only non-native species observed were bullfrog tadpoles and green sunfish in Mill Creek.

Table 9. Counts of fish and non-fish species captured electrofishing during BVET sampling each summer from 2005 to 2007**.**

Year	Tributary	# Habitat units electrofished	Electrofished area (m^2)	Coho yoy (age-0+)	Coho parr (age-1+)	Steelhead yoy/parr	Lamprey Spp.	Sculpin Spp.	Roach	pike minnow	Sacramento sucker	three-spined stickleback	bluegill	green sunfish	CA giant salamander	Rough skinned newt	Foothil yellow-legged frog	Bullfrog tadpole
2005	Palmer	28	1,389	269	0	233	0	55	0	0	0	0	0	0	5	0	0	0
2005	Sheephouse	35	1,213	741	1	115	0	315	0	0	0	0	0	0	0	0	0	0
2005	Gray	31	1,710	247	0	1,318	0	0	298	0	0	0	0	0	43	11	0	0
2006	Mill	35	3,239	82	0	765	128	763	248	1	9	0	1	5	19	0	0	0
2006	Palmer	34	1,399	260	0	367	0	133	0	0	0	0	0	1	25	0	0	0
2006	Sheephouse	35	1,238	308	0	130	0	162	0	0	1	0	0	0	2	0	0	0
2006	Ward	36	2,090	140	0	1,127	0	27	0	0	0	3	0	0	79	1	2	0
2006	Gray	38	1,660	188	0	1,001	0	0	213	0	0	0	0	0	65	8	21	0
2007	Mill	59	4,652	539	0	983	126	1,147	865	0	0	0	0	10	28	0	0	36
2007	Palmer	76	2,726	710	5	581	0	246	0	0	0	0	0	0	12	0	0	0
2007	Sheephouse	42	792	330	6	107	0	152	1	0	0	0	0	0	34	0	0	0
2007	Gray	50	1,351	249	0	713	0	1	157	0	0	0	0	0	201	20	11	0

Mortality

Electrofishing injuries or mortalities that occurred during the BVET samples were minimal (**Table 10**) and did not differ from previous years.

Table 10. Percentage and number of coho and steelhead electrofishing injuries and mortalities during 2005-2007 BVET surveys.

		Coho		Steelhead	
Year	**Tributary**	**Injury**	**Mortality**	**Injury**	**Mortality**
2005	Palmer	0.4% (1/269)	0% (0/269)	0% (0/233)	0% (0/233)
2005	Sheephouse	0.1% (1/741)	0% (0/741)	0% (0/115)	0% (0/115)
2005	Gray	0% (0/247)	0% (0/247)	0.1% (1/1,318)	0.2% (2/1,318)
2006	Mill	1.2% (1/82)	0% (0/82)	0.5% (4/765)	0.5% (4/765)
2006	Palmer	0.8% (2/260)	0.8% (2/260)	0.3% (1/367)	0% (0/367)
2006	Sheephouse	0.3% (1/308)	1.0% (3/308)	0% (0/130)	0% (0/130)
2006	Ward	0.0% (0/140)	0.7% (1/140)	0% (0/1127)	0% (0/1127)
2006	Gray	0.5% (1/188)	0.5% (1/188)	0.1% (1/1001)	0.4% (4/1001)
2007	Mill	0.2% (1/539)	0.2% (1/539)	0.0% (0/983)	0.3% (3/983)
2007	Palmer	0.4% (3/710)	0.0% (0/710)	0.3% (2/581)	0.0% (0/581)
2007	Sheephouse	0.3% (1/330)	0.0% (0/330)	1.9% (2/107)	0.0% (0/107)
2007	Gray	0.4% (1/249)	0.0% (0/249)	0.6% (4/713)	0.4% (3/713)

Note: 2005 injury estimates may be slightly higher; a protocol for documenting injuries was not developed until part-way through the season.

JUVENILE PRESENCE/ABSENCE SURVEYS

Snorkel surveys were conducted during the spring and summer of 2007 in order to document the presence or absence of wild coho salmon yoy in Felta, Green Valley, Dutch Bill and Ward Creeks. In Mill, Palmer, Gray and Sheephouse Creeks, presence/absence surveys were conducted in stocking reaches prior to spring stocking and no wild coho were observed. Complete snorkel and electrofishing surveys were also conducted on Mill, Palmer, Gray and Sheephouse Creeks to quantify spring released coho during the BVET surveys in the summer of 2007. Results for BVET surveys can be found in the Oversummer Survival Estimates section of this report.

Methods

Each creek was divided into reaches and surveys were conducted by two-person teams who snorkeled all pools in each stream reach that had sufficient visibility to detect coho. For each pool snorkeled, the number of coho present, the species composition, and general habitat conditions were recorded. Each coho that was observed was checked for an adipose fin clip to determine wild or hatchery origin.

Results

Felta Creek (4/5, late April)

Capture of two wild coho yoy in the Mill Creek downstream migrant trap in spring 2007 prompted a spring presence/absence dive survey in Felta Creek, since the confluence of Felta and Mill Creek is immediately upstream of the trap site. On April 5, a snorkel survey was conducted in four pools in the vicinity of the Felta Creek Road Bridge near Westside School. Five hatchery coho smolts and two steelhead smolts were observed but no wild coho yoy were found. In late April, a survey was conducted from the mouth of Felta Creek upstream for approximately 1.25 km. No wild coho yoy were observed during this survey.

Of three years of presence /absence surveys conducted in Felta Creek, this was the first year in which no wild coho yoy were observed. During a summer survey in 2005, 33 wild coho yoy were observed , and in a 2006 survey, 40-50 wild coho yoy were observed (**Table 11**).

Green Valley Creek (7/16-7/18)

In 2007, three reaches were surveyed in Green Valley Creek: one in each of the lower, middle, and upper portions of the creek. The reaches spanned from the confluence of Atascadero and Green Valley Creeks to one mile above the Bones Road Bridge. Six pools were snorkeled in the first reach and no coho, seven steelhead (yoy and parr), and several roach, stickleback, and sculpin were observed. The habitat consisted of isolated pools with what appeared to be poor water quality. Twenty eight pools were snorkeled in the second reach, and no wild coho were found. Other species observed included steelhead of multiple life stages, roach, sculpin, stickleback, and bluegill. Fifty-eight pools were snorkeled in the upper reach. No wild coho yoy were observed, and five hatchery coho from the 2006 release were observed. Four of these appeared in good condition, and one had a small amount of fungal growth. The largest diversity of species was also observed in this reach. The species composition consisted of steelhead, sculpin, roach, mosquitofish, and juvenile largemouth bass. Several hundred freshwater shrimp were also seen in the upper reach.

Green Valley Creek historically had three consecutive year-classes of wild coho salmon, resulting in yoy and/or smolts being observed every year until 2005 (**Table 11**). For the fifteen years prior to 2005, wild coho yoy and/or smolts had been observed, trapped, or collected in most years (Cook and Manning 2002; Fawcett et al. 2003; Conrad 2005; CDFG 2006).

Dutch Bill Creek (7/19, 7/23)

In 2007, two consecutive reaches were surveyed in Dutch Bill Creek. These reaches began just below Tyrone Bridge in Monte Rio and ended at the south side of Westminster Woods. Downstream of Tyrone Bridge was considerably dry, with only a few shallow, isolated pools. Twenty-one pools were snorkeled in the first reach. No coho and approximately 1,000 steelhead yoy were observed. Roach, sculpin, and crayfish were also observed. Sixteen pools were snorkeled in the upper reach, and no coho were found. Steelhead of multiple life stages, sculpin, crayfish, and bullfrog tadpoles were observed in this reach.

Dutch Bill Creek historically has one documented year-class of wild coho salmon which does not coincide with this year, but is expected to return during the winter of 2007-2008. Evidence of this single year-class was found during 2005 snorkel surveys with the observation of 118 wild coho yoy (**Table 11**).

Ward Creek (7/25-7/26)

Three reaches were snorkeled on Ward Creek in the summer of 2007. The lower reach began at the mouth and continued upstream approximately 0.41 km to a high gradient area dominated by very large boulders. The middle reach began at river km 0.67 and extended approximately 0.5 km upstream. The upper reach began at river km 3.89 and extended approximately 0.66 km upstream. No wild coho were observed in any reach.

Previous observations of wild coho in Ward Creek include a wild coho yoy captured in the Ward Creek downstream migrant trap in 2005. Two wild coho yoy were subsequently observed during a summer snorkeling survey. No wild coho were found in Ward Creek during the summer 2006 BVET snorkel and electrofishing surveys or in the smolt trap the following spring (**Table 11**).

Summary Table

Table 11 summarizes the number of wild coho yoy observed during spring and summer presence/absence snorkel surveys, summer abundance estimates using snorkel and electrofishing methods, and spring downstream migrant smolt trapping.

Table 11. Total number of wild coho yoy observed during snorkel and electrofishing surveys, and found in downstream migrant traps in recent years.

Cohort [1]	Tributary	Smolt trap	Presence/absence dive survey	Abundance survey	Total
2005	Mill	23 [2]	7 [2]	n/a	30 [2]
2005	Palmer	n/a	0	0	0
2005	Felta	n/a	33	n/a	33
2005	Sheephouse	0	n/a	0	0
2005	Ward	1	2 [3]	n/a	3
2005	Gray	n/a	n/a	0	0
2005	Green Valley	0	0	n/a	0
2005	Dutch Bill	n/a	118	n/a	118
2005	Grape	n/a	0	n/a	0
2006	Mill	3 [2]	0	0	3 [2]
2006	Palmer	n/a	n/a	0	0
2006	Felta	n/a	~40-50	n/a	~40-50
2006	Sheephouse	0	n/a	0	0
2006	Ward	0	n/a	0	0
2006	Gray	n/a	n/a	0	0
2006	Green Valley	n/a	0	n/a	0
2006	Dutch Bill	n/a	0	n/a	0
2007	Dutch Bill	n/a	0	n/a	0
2007	Green Valley	0	0	n/a	0
2007	Mill	2	n/a	0	2
2007	Palmer	n/a	n/a	0	0
2007	Felta	n/a	0	n/a	0
2007	Sheephouse	0	n/a	0	0
2007	Ward	0	0	n/a	0
2007	Gray	n/a	n/a	0	0

[1] Program fish were not stocked until fall 2004.

[2] These fish were thought to have originated in Felta Creek.

[3] These fish possibly originated in Dutch Bill Creek.

ADULT TRAPPING

During the winter season, from November 2007 to February 2008, UCCE assisted CDFG in planning, installing, and monitoring an adult salmonid fixed weir and trap on Mill Creek, a tributary to Dry Creek in the Russian River system. Primary objectives for data collection were to 1) generate coho salmon adult population estimates in combination with spawner and redd surveys, and 2) collect size data on returning hatchery-released and wild coho salmon in program streams. Secondary objectives were to collect similar information for adult steelhead and Chinook salmon and to collect genetic tissue and scale samples from carcasses of adult salmonids.

Methods

A standard picket-style fixed weir and upstream migrant trap box (8' x 4' x 4') were installed with the trap located between the weir and streambank (**Figure 8-9**). Two locations were used during the trapping season (**Figure 10**). Adult trapping was initiated at location #1 on 12/17/07 and continued through 1/2/08. Trapping at location #2 was initiated on 1/19/08 and continued through 2/12/08. Location #1 and #2 were approximately 0.3 and 2.4 km, respectively, from the mouth of Mill Creek at its' confluence with Dry Creek.

Traps were checked by at least two people twice a day during the spawning season. Field procedures for data collection followed methods found in "Weir Mark-Recapture/Resight Protocols" (Gallagher and Neillands 2004). Upon arrival at the trap, the trap box was opened and fish were separated using a mesh live-box. Data was then collected from each fish with the aid of a cradle to both prevent the fish from thrashing and to reduce handling. Fish were then inspected for adipose fin clips, tags, noteworthy scars or injury, and were scanned for PIT tags and coded wire tags. Length and girth measurements were obtained and scales were collected for age determination. Prior to release, adults were tagged with neon Floy T-bar anchor tags and each fish received a hole punch in the upper lobe of the caudal fin, both enabling re-sighting in subsequent spawner surveys and providing a genetic sample. Different colored Floy tags and caudal punch shapes were used each week throughout the adult spawning season.

Figure 8. Mill Creek weir and trap looking downstream.

Figure 9. Mill Creek weir and trap looking upstream.

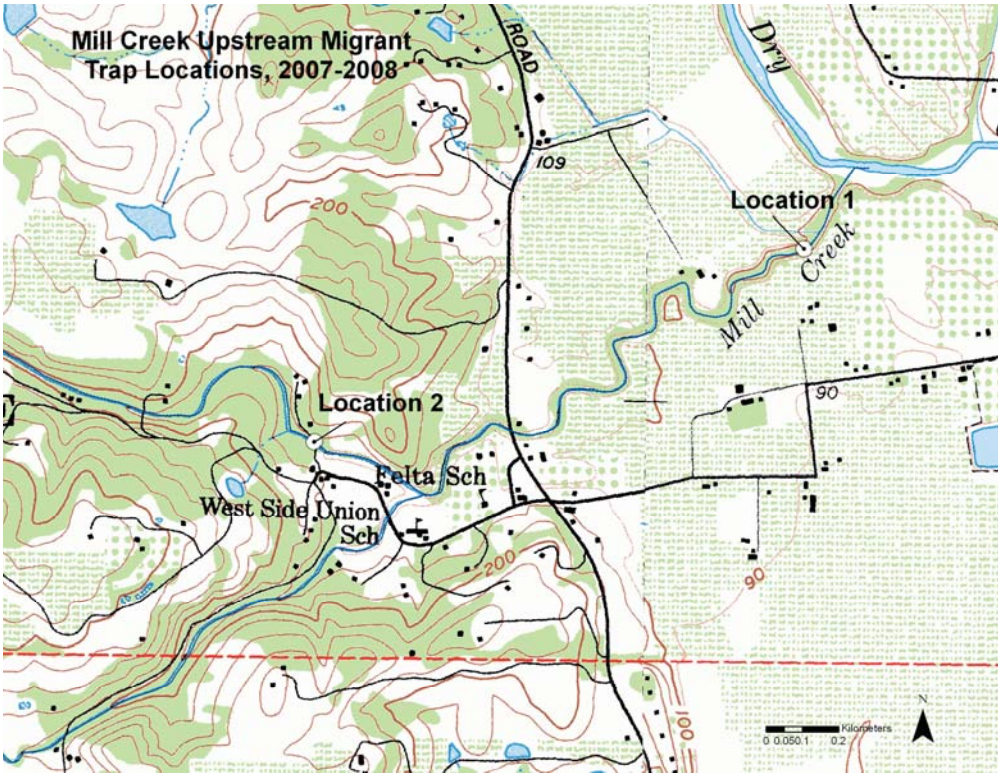

Figure 10. Mill Creek upstream migrant trap locations 1 and 2.

Results

A very large storm with heavy flow over-topped the weir and trap box on 1/2/08 and partially buried and disabled the trap. Most of the weir panels and trap box were recovered and repaired after flows receded. A more suitable location with a wider stream channel was located upstream of location #1 and the weir and trap were relocated. This site proved to be an improvement over the initial location. No coho or Chinook salmon were trapped at either location, and no steelhead were trapped at location #1. A total of nine adult steelhead were caught at the weir moving upstream from 1/23/08 through 2/12/08 at location #2. Five of the nine steelhead had adipose clips indicating hatchery origin, and four with intact adipose fins were presumed to be wild fish. Of the five hatchery origin steelhead, two were female and three were male. These hatchery origin steelhead ranged from 56 cm to 78 cm. Four of the five hatchery steelhead were PIT tagged prior to release. All of the hatchery steelhead were Floy tagged and fin clips were collected for genetic analysis. One of the hatchery origin steelhead males had a caudal punch indicating that on at least one occasion, it had previously been processed at the Warm Springs Fish Hatchery. Due to the low number of returns there was insufficient data to estimate the total number of adult returns; therefore, nine returning adult steelhead should be considered a minimum count.

Of the four wild steelhead captured in the trap, two were female and two were male, and ranged in size from 69 cm to 78.5 cm. One unspawned female fish was recovered as a mortality and the carcass was taken to the Warm Springs Hatchery. The fish was found facing downstream apparently having become trapped in the acute angle created by the entry doors and the side panel of the trap. New trap boxes will be designed to prevent this from reoccurring. The remaining three wild steelhead were tagged with both Floy and PIT tags, and fin clips were collected for genetic analysis (**Figure 11**).

Figure 11. Floy-tagged wild male steelhead ready for release upstream of trap.

Another steelhead tagged on 2/9/08 was observed with an un-tagged steelhead on 2/19/08 in lower Mill Creek during a spawner survey (**Figure 12**). Two steelhead with Floy tags were observed by a forestry crew in upper Felta Creek above the mouth of Salt Creek spawning over a redd in late February.

Figure 12. Steelhead tagged on 2/9/08 observed with un-tagged steelhead on 2/19/08

ADULT SPAWNER AND REDD SURVEYS

During the winter season (November – March), adult salmonid spawner and redd surveys were completed on Mill, Felta, Palmer, Dutch Bill, Gray and Sheephouse Creeks (**Figure 13**). Primary objectives for data collection were to (1) generate adult population estimates and (2) locate, measure and enumerate coho salmon redds for returning hatchery-released and wild coho salmon in program streams. Secondary objectives were to collect similar information for adult steelhead and Chinook salmon and collect genetic tissue from carcasses of adult salmonids.

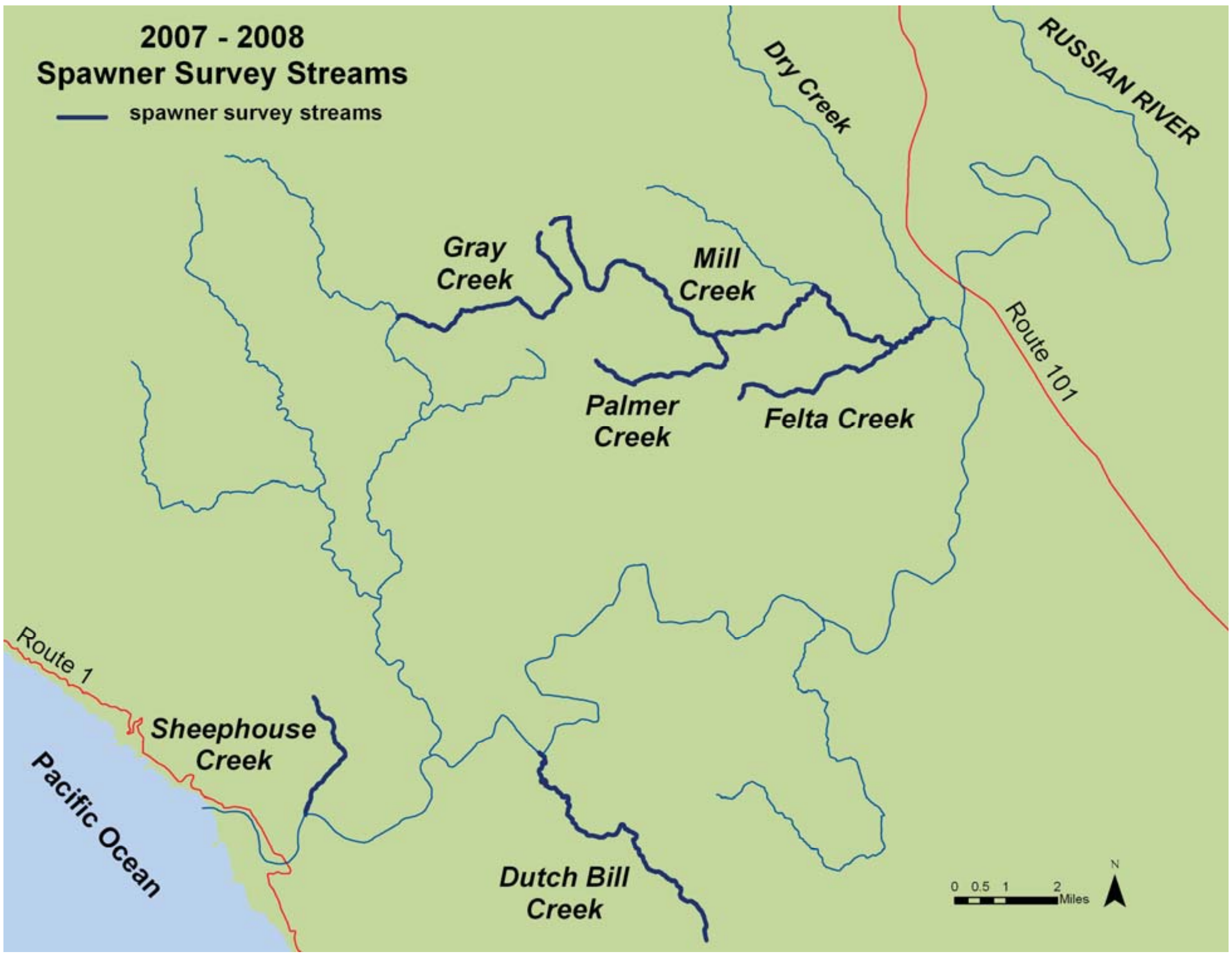

Figure 13. Redd and spawner survey streams for the winter 2007-2008 season.

Methods

Spawner and redd surveys were initiated during the last week of November and continued through the middle of March at the onset of downstream migrant trapping. Weekly surveys of each creek began once flows were sufficient to allow entrance of adult salmonids into the tributaries and continued throughout the winter season. Surveys were postponed when flows became high enough to inhibit surveyor safety and visibility of fish and redds, and were completed as soon as flows subsided to safe levels with sufficient visibility. Streams were divided into reaches that could be effectively surveyed by crews of two people in a single day.

Surveys began at the mouth and continued upstream to the end of known anadromy. Extensive high gradient reaches with minimal or no spawning habitat were not surveyed. Four reaches were surveyed on Mill Creek, beginning at its confluence with Dry Creek and extending upstream to the mouth of Angel Creek. These four reaches ranged from 2.47 km to 4.24 km in length, totaling 13.50 km in length. Dutch Bill Creek was split into two reaches, each approximately 4.45 km, totaling 8.9 km in length. Surveys on Felta (2.66 km), Gray (3.7 km), Palmer (2.12 km) and Sheephouse Creeks (3.55 km) consisted of one reach due to their shorter total stream lengths.

Field procedures and data collection for spawner and redd surveys followed methods found in "Redd Counts" (Gallagher et. al 2007). These protocols included measuring redd area and substrate, flagging and monitoring redd ages, taking flow measurements, mapping redd locations (GPS), identifying species, sex and origin (wild or adipose-clipped) of fish, and identifying redd species. If a redd was devoid of fish, it was identified to species, if possible, using redd size and dimensions, substrate size, and spawn timing as classification factors. If these factors were insufficient to enable accurate classification, logistic regression analysis equations (Gallagher and Gallagher 2005) were used to discriminate between Chinook, coho or steelhead redds.

Results

<u>Mill Creek</u>

The first spawner surveys on reach one of Mill Creek occurred during the week of 12/10/07 to determine whether Mill was accessible to upstream migrating fish. At this time, the mouth of the creek was still dry at the confluence with Dry Creek. There was enough rain to open the mouth of Mill Creek during the week of 12/17/07. A total of 35 surveys were conducted between 12/10/07 and 3/19/08 (**Table 12**). Significant rainfall occurred during the weeks of 12/31/07 and 1/28/08 and no surveys were completed at that time due to high flows. Surveys were terminated on 3/10/08 with the installation of the downstream migrant trap, with the exception of one survey below the downstream migrant trap on 3/17/09.

No live coho salmon, coho salmon carcasses, or coho salmon redds were observed in Mill Creek during the 2007-2008 spawner survey season, and a total of 121 live steelhead adults were observed. (**Table 12**). In reaches one through four, we observed 71(including three jacks), 10, 29 and 11 live steelhead adults, respectively. Of these 121 steelhead adults, 60 were male, 43 were female and 18 were of unknown sex. Adipose fins were observed on 39 steelhead, indicating wild origin, 29 were adipose-clipped, indicating hatchery origin, and 53 were of unknown origin. In addition to live fish, 15 steelhead carcasses were observed during the spawning season; eight males, three females and three of unknown sex. Eight of these carcasses were of wild origin, four of hatchery origin, and three of unknown origin. In addition, one female Chinook salmon carcass was observed in reach one on 2/8/08. A total of 77 steelhead redds were observed in Mill Creek during the 2007-2008 spawning season (**Table 12**, **Figure 14**), with reaches one through four having 42, 9, 10 and 16 redds, respectively.

Table 12. Coho and steelhead adults and redds observed on coho program streams during 2007-2008 redd and spawner surveys.

	Mill Creek 4 reaches (0.0 km to 14.1km)					Felta Creek [1] 1 reach (0.0 km to 1.8 km)					Palmer Creek 1 reach (0.0 km to 2.8 km)				
Week Beginning	**Reaches Surveyed**	**Live Coho**	**Coho Redds**	**Live Sthd**	**Sthd Redds**	**Reaches Surveyed**	**Live Coho**	**Coho Redds**	**Live Sthd**	**Sthd Redds**	**Reaches Surveyed**	**Live Coho**	**Coho Redds**	**Live Sthd**	**Sthd Redds**
11/26	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
12/3	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
12/10	1	0	0	0	0	1	0	0	0	0	0	ns	ns	ns	ns
12/17	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
12/24	4	0	0	0	0	1	0	0	0	0	1	0	0	0	0
12/31	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
1/7	1	0	0	0	0	0	ns	ns	ns	ns	0	ns	ns	ns	ns
1/14	4	0	0	10	3	0	ns	ns	ns	ns	1	0	0	0	0
1/21	4	0	0	5	5	1	0	0	0	0	0	ns	ns	ns	ns
1/28	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
2/4	4	0	0	20	7	0	ns	ns	ns	ns	1	0	0	4	1
2/11	4	0	0	7	3	1	0	0	0	3	1	0	0	0	4
2/18	4	0	0	11	14	1	0	0	0	0	1	0	0	0	3
2/25	4	0	0	22	7	1	0	0	3	1	1	0	0	2	2
3/3	4	0	0	39	20	stopped spawner surveys					1	0	0	0	2
3/10	0	ns	ns	ns	ns						stopped spawner surveys				
3/17 [2]	1	0	0	13	18										
TOTALS	**35**	**0**	**0**	**127**	**77**	**6**	**0**	**0**	**3**	**4**	**7**	**0**	**0**	**6**	**12**
2006-2007 [3]	38	1	1	28	22	9	0	0	0	2	8	0	0	2	3

Notes

ns - Indicates that spawner surveys were not conducted due to low flows (mouth closures) or high flows (high turbidity).

[1] Approximately 1 km of spawning habitat was not surveyed due to lack of landowner access.

[2] Mill Creek Reach 1 only.

[3] 2006-2007 spawner surveys ended the week of March 12, 2007.

Table 12 (cont.). Coho and steelhead adults and redds observed on coho program streams during 2007-2008 redd and spawner surveys.

	Sheephouse Creek 1 reach (0.0 km to 3.6 km)					**Dutch Bill Creek** 2 reaches (0.0 km to 8.9 km)					**Gray Creek** 1 reach (0.0 km to 3.7 km)				
Week Beginning	**Reaches Surveyed**	**Live Coho**	**Coho Redds**	**Live Sthd**	**Sthd Redds**	**Reaches Surveyed**	**Live Coho**	**Coho Redds**	**Live Sthd**	**Sthd Redds**	**Reaches Surveyed**	**Live Coho**	**Coho Redds**	**Live Sthd**	**Sthd Redds**
11/26	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
12/3	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
12/10	1	0	0	0	0	2	0	0	0	0	0	ns	ns	ns	ns
12/17	1	0	0	0	0	0	ns	ns	ns	ns	0	ns	ns	ns	ns
12/24	1	0	0	0	0	2	0	0	0	0	0	ns	ns	ns	ns
12/31	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
1/7	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
1/14	1	0	0	0	1	2	0	0	1	1	1	0	0	0	1
1/21	1	0	0	0	0	2	0	0	2	0	0	ns	ns	ns	ns
1/28	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
2/4	0	ns	ns	ns	ns	2	0	0	0	0	0	ns	ns	ns	ns
2/11	1	0	0	0	0	2	0	0	2	0	1	0	0	0	7
2/18	1	0	0	0	1			stopped spawner surveys			1	0	0	0	0
2/25			stopped spawner surveys										stopped spawner surveys		
3/3															
3/10															
3/17 [2]															
TOTALS	**7**	**0**	**0**	**0**	**2**	**12**	**0**	**0**	**5**	**1**	**3**	**0**	**0**	**0**	**8**
2006-2007 [3]	13	0	0	1	3	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Notes

ns - Indicates that spawner surveys were not conducted due to low flows (mouth closures) or high flows (high turbidity).

[1] Approximately 1 km of spawning habitat was not surveyed due to lack of landowner access.

[2] Mill Creek Reach 1 only.

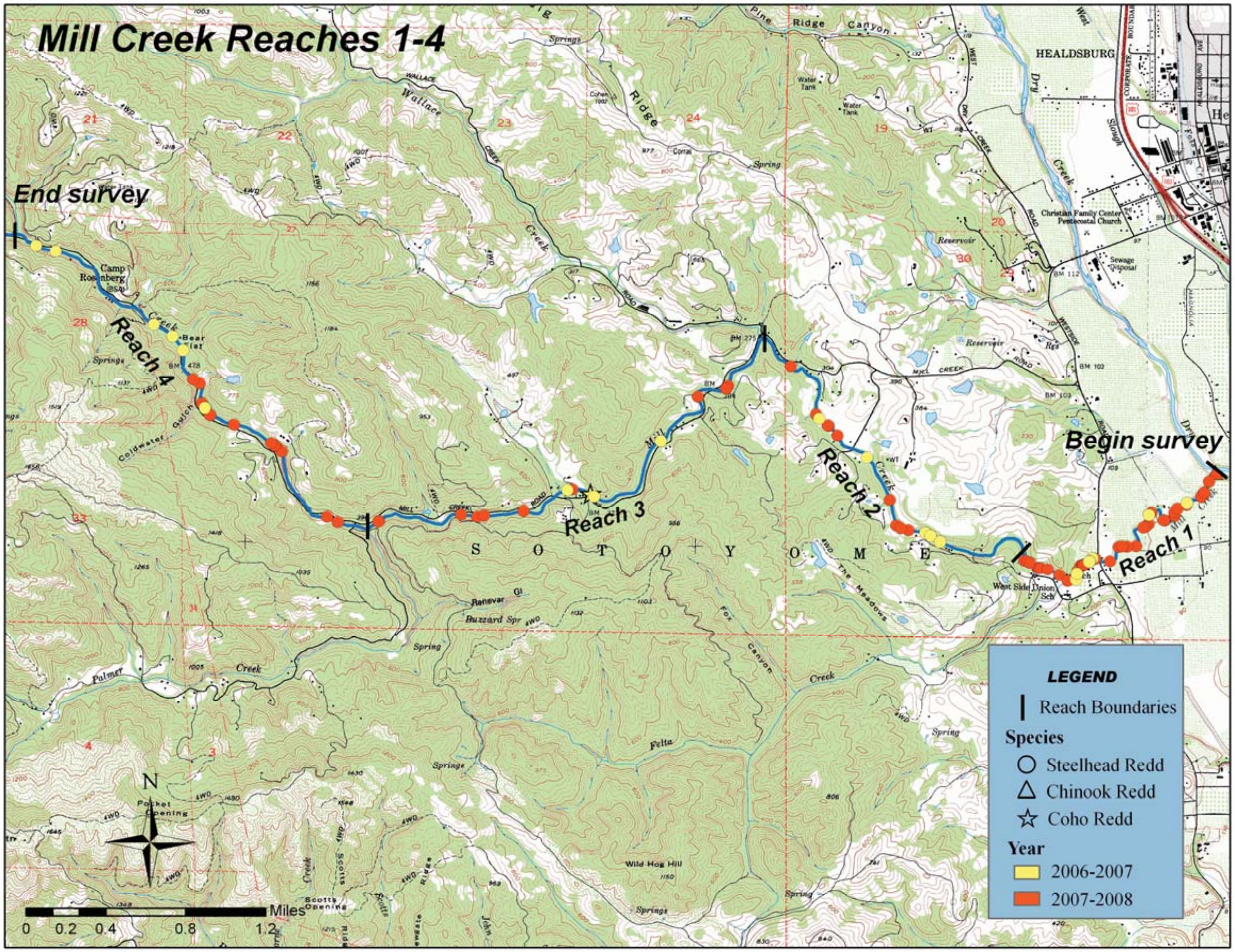

Figure 14. Coho and steelhead redds observed in Mill Creek spawner/redd surveys during winters 2006-2007 and 2007-2008.

Felta Creek

Spawner surveys began on Felta Creek during the week of 12/10/07, coinciding with rains opening the mouth of Mill Creek. Felta is a tributary of Mill, therefore spawning adults could not access Felta until the mouth of Mill was open. There were a total of six surveys completed through the week of 2/25/07 (**Table 12**).

No coho salmon, live or carcasses, or redds were observed during these surveys. Three live steelhead adults were observed; two males and one of unknown sex. One of the males was of wild origin, one was of hatchery origin and the third was of unknown origin. Four steelhead redds were observed in Felta Creek during the 2007-2008 spawner season (**Table 12**, **Figure 15**).

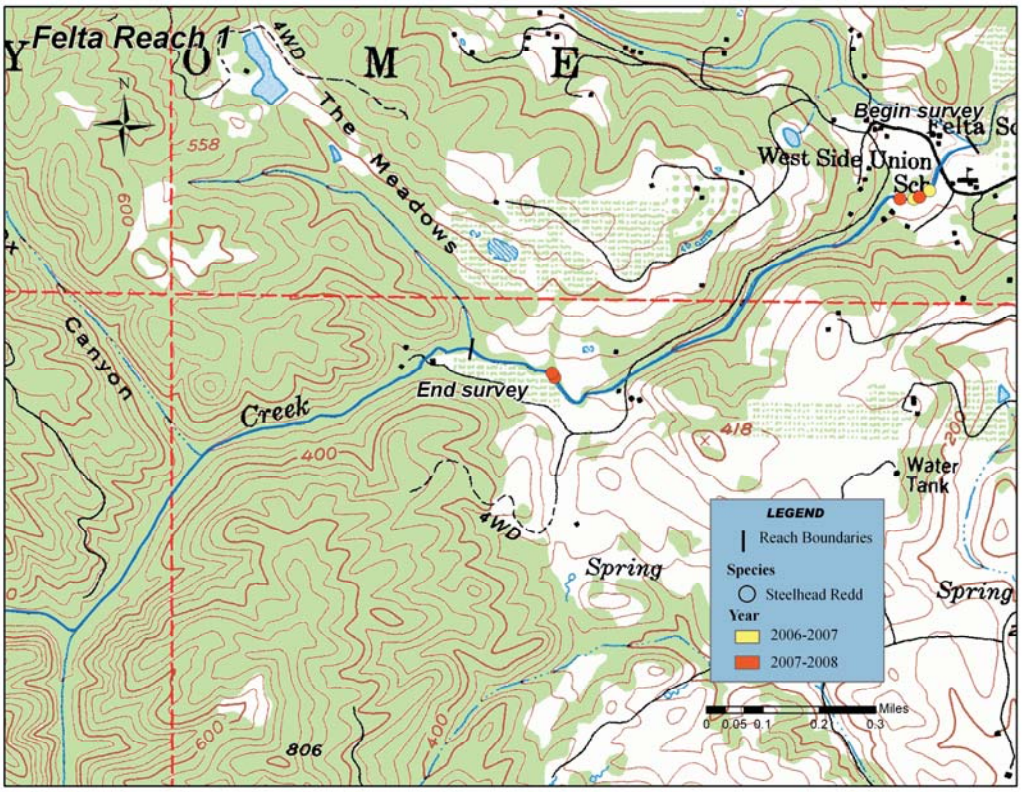

Figure 15. Coho and steelhead redds observed in Felta Creek spawner/redd surveys during winters 2006-2007 and 2007-2008.

Palmer Creek

Spawner surveys began on Palmer Creek during the week of 12/26/07, after the rains opened the mouth of Mill Creek. Palmer is a tributary of Mill, therefore spawning adults could not access Palmer until the mouth of Mill Creek was open. There were a total of seven surveys completed through the week of 3/3/08.

No coho salmon, live or carcasses, or redds were observed during the 2007-2008 spawning season on Palmer Creek. Six live steelhead adults were observed; three males, two females and one of unknown sex. One fish was of wild origin and the five others were of unknown origin. Two steelhead adult carcasses were also observed; one wild female and one male of unknown origin. Twelve steelhead redds were observed during 2007-2008 spawner surveys **(Table 12, Figure 16)**.

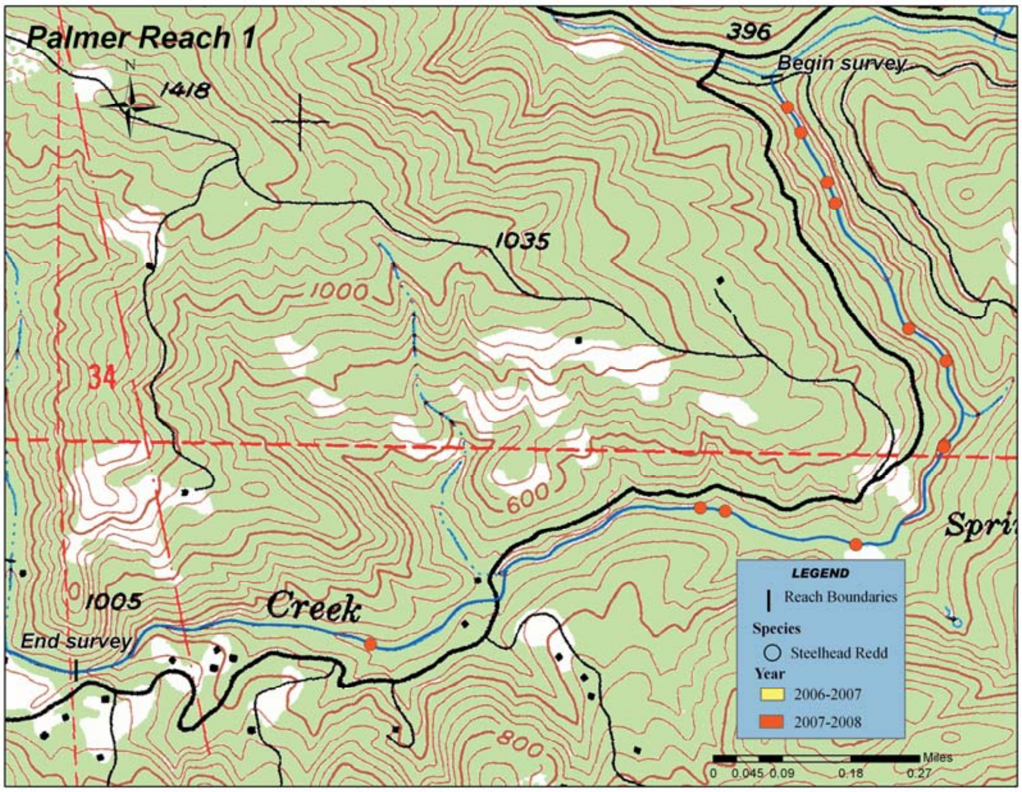

Figure 16. Coho and steelhead redds observed in Palmer Creek spawner/redd surveys during winters 2007-2008. Locations for redds observed in 2006-2007 were not documented.

Sheephouse Creek

Spawner surveys began on Sheephouse Creek during the week of 12/10/07 and continued through the week of 2/18/08. A total of seven surveys were completed during the 2007-2008 spawning season (**Table 12**).

No coho salmon, live or carcasses, or redds were observed during these surveys. No live steelhead and two steelhead redds were observed through the week of 2/18/08 (**Table 12**, **Figure 17**).

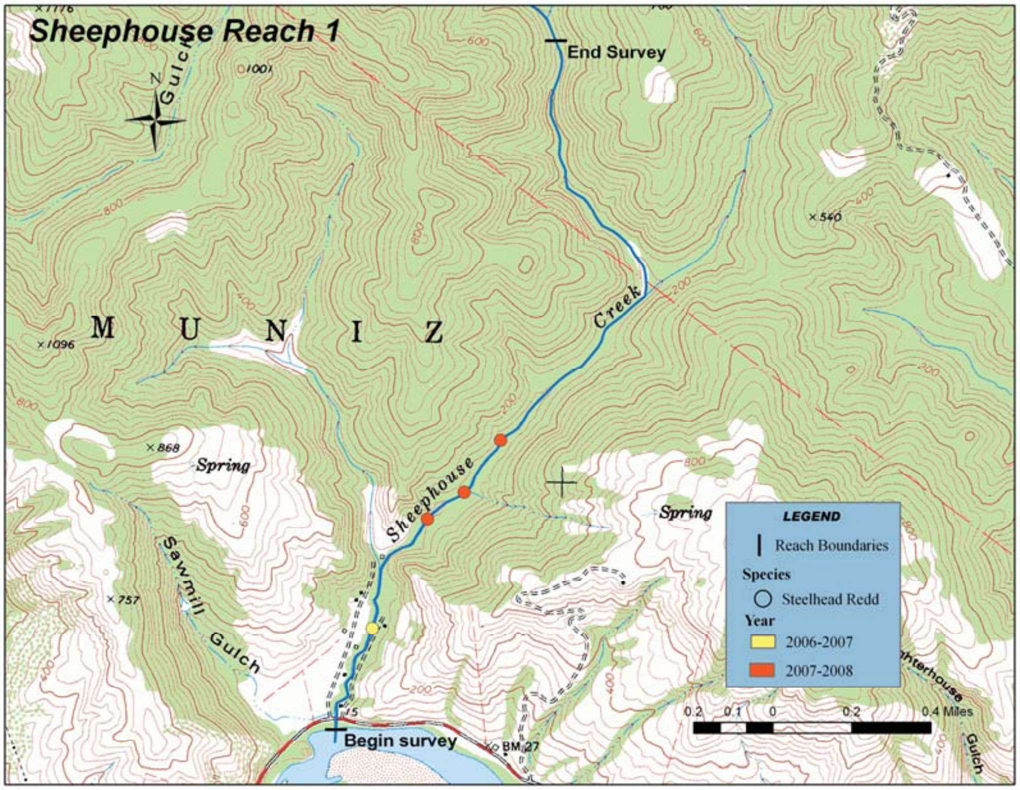

Figure 17. Steelhead redds observed in Sheephouse Creek spawner/redd survey reach 1, map 1 during winters 2006-2007 and 2007-2008.

Gray Creek

Spawner surveys began on Gray Creek during the week of 1/14/08 and were conducted opportunistically as flow conditions allowed access to the stream. A total of three surveys were completed during the 2007-2008 spawning season (**Table 12**).

No coho salmon, live or carcasses, or redds were observed during these surveys (**Table 12**, **Figure** 18). No live steelhead and a total of eight steelhead redds were observed.

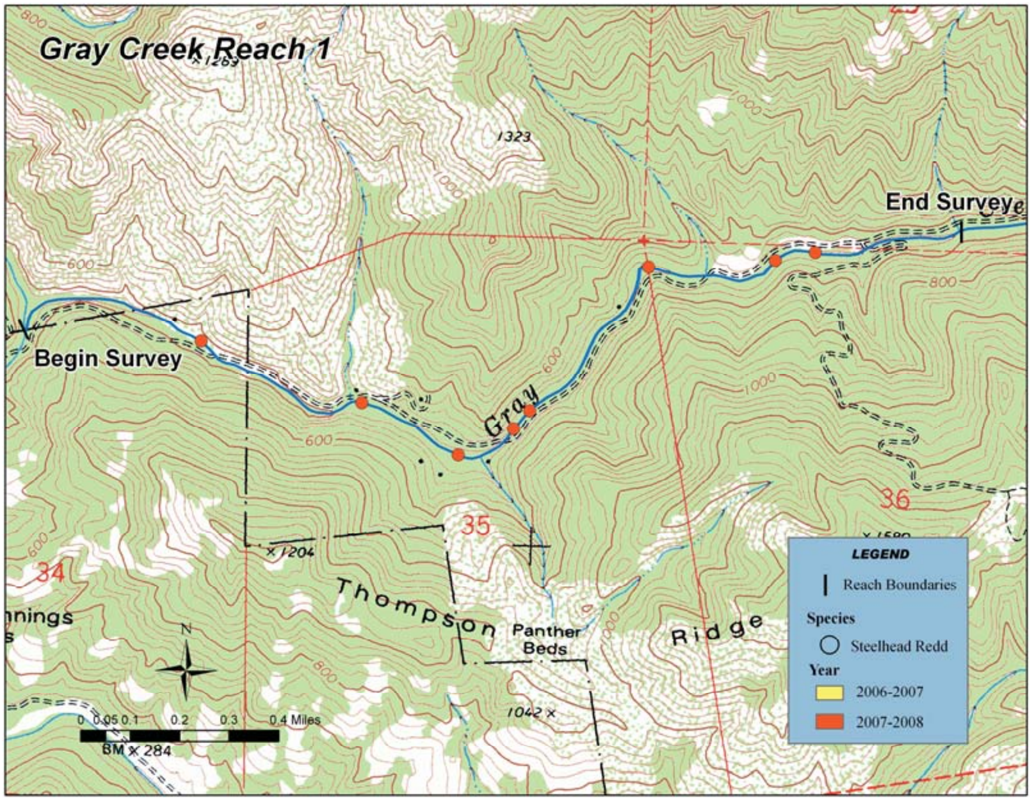

Figure 18. Steelhead redds observed in Gray Creek spawner/redd surveys during winters 2006-2007 and 2007-2008.

Dutch Bill Creek

Spawner surveys began on Dutch Bill Creek during the week of 12/10/07 and continued through the week of 2/11/08. A total of six surveys were completed during the 2007-2008 spawning season (**Table 12**).

No coho salmon, live or carcasses, or redds were observed during these surveys. Five live steelhead and one steelhead redd were observed (**Table 12**, **Figure 19**).

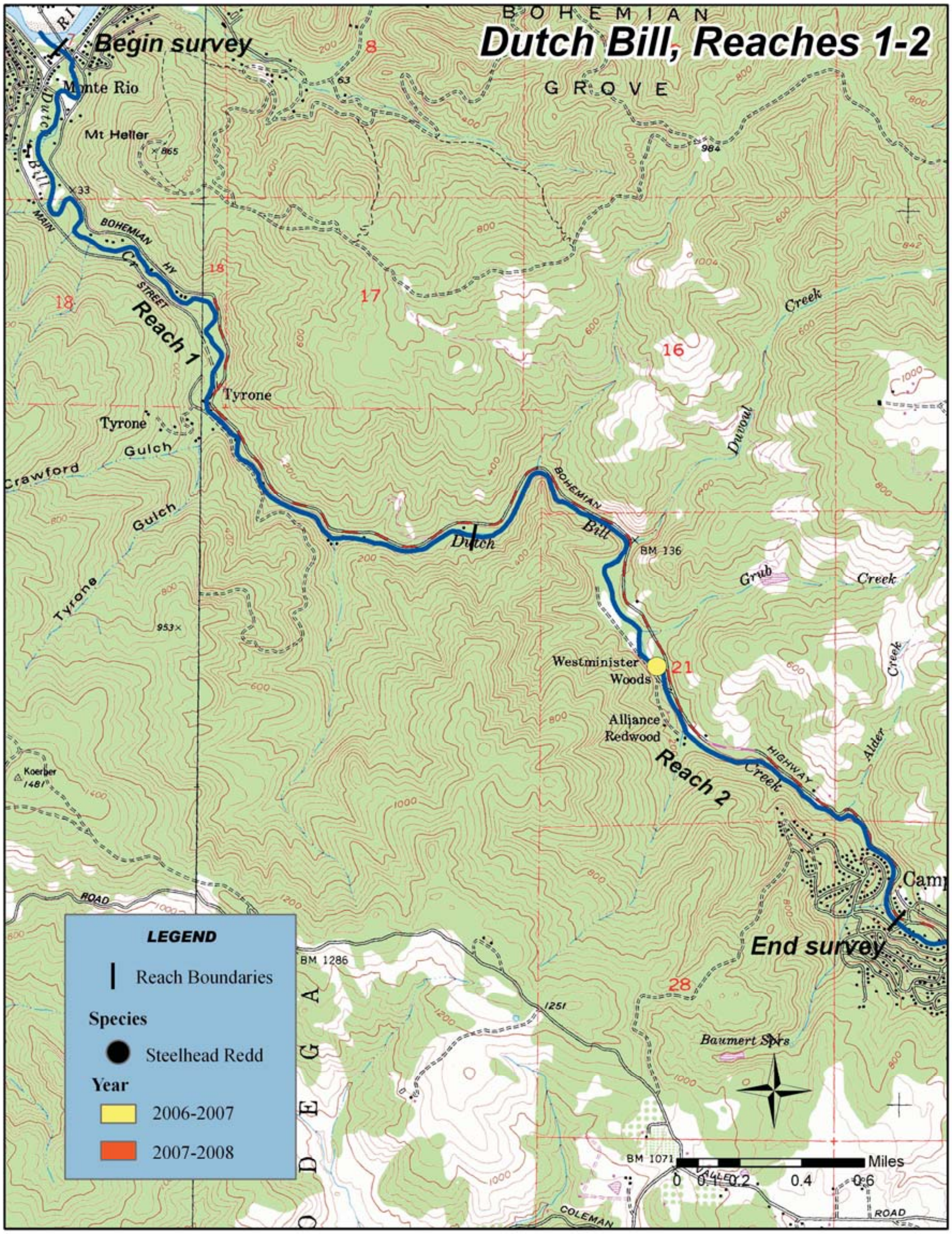

Figure 19. Steelhead redds observed during Dutch Bill Creek spawner/redd surveys during winter 2007-2008.

OVERWINTER SURVIVAL ESTIMATES

During the spring season (March-June), downstream migrant traps were operated on Mill, Green Valley and Sheephouse Creeks (**Figure 20**). Primary objectives for data collection were: (1) to estimate the number and migration timing of program coho smolts leaving each system, (2) evaluate overwinter survival and growth of coho smolts stocked the previous spring and/or fall, and (3) compare overwinter survival and fish size/condition between spring and fall stocked fish in Mill and Palmer Creeks. Secondary objectives were to collect genetic samples from coho and steelhead, and count all other fish and amphibian species captured in the traps.

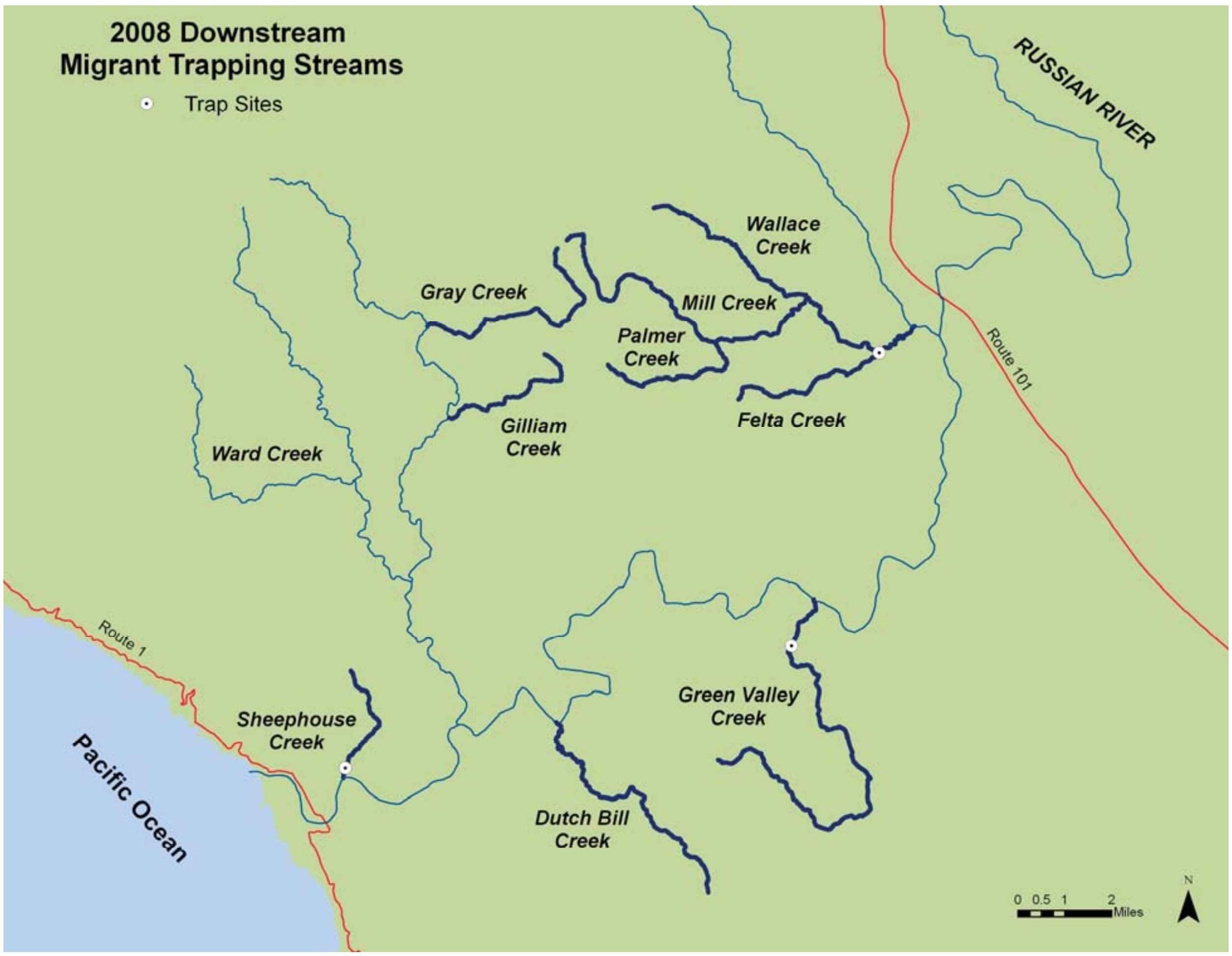

Figure 20. Spring 2008 downstream migrant trap locations on streams stocked with coho yoy in 2007.

Methods

Downstream Migrant traps

Funnel net traps with fixed weirs were operated on Mill (3/11/08-5/18/08) and Green Valley Creeks (3/13/08-6/9/08) (**Figure 21a**). A pipe trap and weir was used on Sheephouse Creek (3/12/08-6/9/08) and on Mill Creek (5/19/08-6/12/08) when flows dropped significantly in the spring (**Figure 21b**). The funnel traps included removable weir panels constructed of wooden framing with vexar screening. Each weir led into an 18' funnel-shaped net which was connected to a 3' section of 6" PVC pipe at the cod end and led into a 35"W x 40"H x 62"L wooden-framed holding box. V-shaped flow deflectors were placed inside the holding boxes to provide fish with relief from the current during high flows. Trap sites were located near the mouths of the creeks to sample as much habitat as possible. The mouth of each trap was placed at the downstream end of a riffle and the cod end of the net and holding box were placed in calmer water. On Sheephouse Creek, the pipe trap design consisted of a vexar weir placed at the tailout of a pool which channeled water into a 40' section of 6" PVC pipe leading into a 29"W x 34"H x 48"L holding box. The pipe trap on Mill Creek was comparable to the Sheephouse Creek trap with the exception of a 28' PVC pipe instead of 40' pipe.

To estimate the abundance of downstream migrating coho salmon and steelhead smolts, a capture-mark-recapture (CMR) study was conducted on each creek. Coho salmon and steelhead smolts were marked daily with fin clips and released a minimum of two pool/riffle sequences upstream of the trap. A different fin clip was applied each week based on an eight week rotation. This required the assumption that marked fish would survive and re-emigrate within eight weeks of their upstream release. The proportions of marked and unmarked fish captured in the traps were used to estimate weekly trap efficiencies and seasonal smolt abundance using Program DARR (Bjorkstedt 2000, Bjorkstedt 2005, CDFG 2003). The Mill Creek trap was used to capture and estimate abundance of program coho outmigrating from both Mill and Palmer Creeks, as Palmer Creek is a tributary of Mill Creek.

Traps were checked a minimum of one time per day while in operation. Each day upon arrival, fish were netted into aerated buckets for sampling work-up. Juvenile salmonids were anesthetized, measured for length and weight, and scanned with a coded-wire detection wand to determine presence and location of a coded-wire tag (CWT). These fish were also scanned for the presence of passive integrated transponder (PIT) tags. CWT locations and PIT tag numbers were later used to determine the stream and season that the fish were stocked. Every new fish was checked for the presence of an adipose fin clip to determine whether it was a hatchery-released program fish (clipped adipose fin) or a wild fish (intact adipose fin). For the CMR estimates, a maximum of 15 newly captured coho and steelhead smolts received a fin clip each day. Tissue from the fin clips were preserved for genetic analysis. For recaptured coho and steelhead smolts, fin clip locations were recorded and then the fish were immediately placed in a recovery bucket and released downstream to minimize processing time. Coho, Chinook and steelhead yoy and parr were measured for length and weight (up to 20 individuals per species per day). Downstream migrating steelhead adults were sexed, checked for adipose clips, estimated for length, and immediately released downstream. Lampreys were identified to species when possible and length and weight measurements were taken on adults. All other fish, amphibians, crustaceans and other aquatic species were tallied. After processing, fish were placed in aerated buckets for recovery and then released downstream of the trap. Before leaving the trap site, debris was removed from the weir, net and box, and the trap was inspected for holes or other potential problems. The Mill Creek trap and weir was often cleaned a second time each day in the late afternoon to remove excess debris.

PIT tag detection system

On Mill Creek, a 16’ x 2’ stationary swim-through PIT tag antenna was placed approximately10m upstream of the Mill Creek trap and weir. The antenna was connected to a battery-powered transceiver placed in a water-tight box on the streambank. As PIT tagged fish swam through the antenna, the PIT tag number, date, and time was recorded on the transceiver. Individual data collected on PIT tagged fish that passed through the transceiver was used to estimate weekly trap efficiency in Program MARK. Smolt abundance and overwinter survival were then estimated for the four release groups in the Mill Creek system (Mill spring, Mill fall, Palmer spring, Palmer fall).

a.

b.

Figure 21. Trap designs used on Green Valley Creek (a) and Sheephouse Creek (b) in 2008. The funnel trap used on Green Valley Creek was similar to trap design used on Mill Creek while the pipe trap design was used on Sheephouse Creek and on Mill Creek at the end of the spring.

Results

Installation and operation of downstream migrant traps

During spring 2008, the Mill Creek trap was installed on 3/11 and fished through 6/12 for a total of 96 days fished. The Sheephouse Creek trap was installed on 3/12 and fished through 6/9, for a total of 90 days fished. The Green Valley Creek trap was installed on 3/13 and fished through 6/9, for a total of 89 days fished. Traps were checked seven days a week by UCCE staff with the assistance of AmeriCorps volunteers.

Salmonid trap counts

In 2008, a total of 5,100 program coho smolts were captured in Mill, Green Valley and Sheephouse Creeks combined (**Table 13)**. One wild coho smolt was captured during the 2008 season in the Mill Creek trap. We are unsure of the origin of the wild coho smolt but believe it to be from the Mill or Dry Creek region. In addition to coho smolts, a total of 190 steelhead smolts (40 hatchery), 4,620 steelhead yoy/parr, 16 steelhead adults (13 wild, 3 of hatchery origin), 71 Chinook yoy, and 35 wild coho yoy (Felta Creek origin) were captured in the traps in 2008 (**Table 13**).

Tag retention

All program coho released in 2007 received a CWT tag in the snout (S) and/or adipose (A) region (**Table 14**). Additionally, a portion of fish stocked into Mill and Palmer during the spring and fall were PIT tagged (**Table 14**). During fish processing at the downstream migrant traps, coho smolts were scanned with a CWT detection wand and presence and location of the CWT were recorded to determine tributary and season of release (**Table 15**). PIT tagged fish (with known CWT locations) were used to determine detection and classification rates of CWT tag locations at the downstream migrant traps (**Table 16**). Detection of the presence of a CWT was high; overall, the CWTs detection rate ranged from 97% on Green Valley Creek to 100% on Mill and Sheephouse Creeks (**Table 15**). However, in PIT tagged fish, the observed CWT location did not consistently match the CWT location applied (**Table 16**). Correct assignment rates were 96% for SA tagged fish, 71% for S tagged fish, and 91% for A tagged fish. The misclassification rates were particularly problematic for the spring released fish in Palmer Creek; of 83 fish classified as A at the downstream migrant trap, only 51 (or 61%) were tagged with A. These classification rates were used to adjust the observed CWT locations in all fish before estimating smolt abundance and overwinter survival of the four release groups on Mill and Palmer (Mill spring, Palmer spring, Mill fall and Palmer fall).

Table 13. Number, species, and life stage of wild (W) and hatchery (H) salmonids captured in downstream migrant traps, 2005-2008.

		Chinook	Coho				Steelhead				
		yoy	yoy		smolt		yoy/parr	smolt		adult	
Year	Tributary	W	W	H[1]	W	H	W	W	H	W	H
2005	Mill	70	23	1	2	632	1,904	96	7	5	4
2005	Sheephouse	2	0	3,348	0	294	123	14	1	0	0
2005	Ward	0	1	0	0	87	668	5	0	1	0
2005	Green Valley	925	0	0	9	6 [3]	1,723	49	0	0	1
2006	Mill	128	3	311	1	645	438	48	1	1	4
2006	Sheephouse	0	0	0	1 [2]	140	80	17	0	0	0
2006	Ward	0	0	26	0	125	363	25	0	2	0
2007	Mill	2	2	56	1	2,163	2,271	197	31	25 [4]	6
2007	Sheephouse	0	0	0	1	125	67	12	1	1	0
2007	Ward	0	0	0	0	128	758	41	0	19	1
2007	Green Valley	226	0	0	1	506	36	68	1	7	1
2008	Mill	31	35	8	1	4,759	4,105	121	37	12	3
2008	Sheephouse	0	0	0	0	42	18	3	0	0	0
2008	Green Valley	40	0	0	0	299	497	26	3	1	0

[1] Hatchery coho yoy are program fish that were stocked in the spring of each year prior to downstream migrant trap removal.

[2] This was an age-2+ fish of unknown origin; no CWT but possible adipose fin clip (fin looked deformed).

[3] These fish strayed from another program stream; Green Valley Creek was not stocked with coho in 2004.

[4] Includes two adult steelhead of unknown origin.

Table 14. Annual tagging strategies by stream and season for 2004-2007 coho releases into Russian River tributaries. Locations for CWT are as follows: S=snout, A= adipose/peduncle region, SA=snout and adipose/peduncle region.

Release Year	Tributary	Spring		Fall		
		CWT Location	PIT (#tagged/total)	CWT Location	VIE	PIT (#tagged/total)
2004	Mill	*no stocking*	*0*	S	*none*	*0*
2004	Sheephouse	*no stocking*	*0*	S	*none*	*0*
2004	Ward	*no stocking*	*0*	S	*none*	*0*
2005	Mill	*no stocking*	*0*	A	*none*	*0*
2005	Palmer	S	*0*	SA	*none*	*0*
2005	Sheephouse	*S*	*0*	A	*none*	*0*
2005	Ward	*no stocking*	*0*	A	*none*	*0*
2005	Gray	S	*0*	SA	*none*	*0*
2006	Mill	S	*0*	SA	red upper caudal	*0*
2006	Palmer	A	*0*	SA	green lower caudal	*0*
2006	Sheephouse	S	*0*	SA	*none*	*0*
2006	Ward	S	*0*	*no stocking*	*no stocking*	*0*
2006	Gray	A	*0*	SA	*none*	*0*
2006	Green Valley	*no stocking*	*0*	S	*none*	*0*
2006	Dutch Bill	*no stocking*	*0*	S	*none*	*0*
2007	Mill	S	1,486/8,038	SA	*none*	2,216/25,154
2007	Palmer	A	1,483/3,967	SA	*none*	2,227/3,880
2007	Sheephouse	S	*0*	*no stocking*	*none*	*0*
2007	Gray	A	*0*	S	*none*	*0*
2007	Gilliam	*no stocking*	*0*	SA	*none*	*0*
2007	Green Valley	*no stocking*	*0*	S	*none*	*0*
2007	Dutch Bill	*no stocking*	*0*	S	*none*	*0*

Table 15. Number and location of CWT detections in program coho smolts captured in downstream migrant traps in 2008. Locations for CWT are as follows: S=snout, A= adipose region, SA=snout and adipose region, NT= scanned and no tag detected.

Tributary	S	A	SA	NT	Not scanned
Mill	174	300	4,276	4	7
Sheephouse	40	1	0	0	1
Green Valley	286	0	2	9	2

Table 16. CWT location detections for PIT tagged fish captured at the Mill downstream migrant in relation to CWT locations applied prior to release. Locations for CWT are as follows: S=snout, A= adipose region, SA=snout and adipose region. Shaded areas represent correct assignment.

CWT location applied	CWT location detected		
	A	S	SA
A	51	0	5
S	3	22	6
SA	29	7	832

Run-timing

In 2008, the first coho smolts were captured on the first day of trapping on Mill Creek (3/11), and the last coho was captured on 6/11 on Mill Creek (**Figure 22**). Clear peaks in run timing were apparent in Mill and Green Valley Creeks, with Mill smolts peaking around 5/8 and Green Valley smolts peaking almost two weeks later on 5/21. This run-timing trend was evident on Mill and Green Valley Creeks in 2007 as well. Sheephouse Creek showed no clear peak in migration timing. Low flow conditions during trapping led to mouth closure on each trapping stream prior to the end of the smolt run (**Figure 22**). Once the streams were disconnected, fish captured in the Mill trap were transported and released into Dry Creek and those captured in Green Valley and Sheephouse were transported and released into the mainstem of the Russian.

Trap efficiencies

Recapture rates on Green Valley and Sheephouse Creeks in 2008 were lower than in previous years; 0.03 on Green Valley and 0.43 on Sheephouse Creek. We suspect that these low recapture rates did not result from poor trap efficiency, but from trap avoidance or mortality of fish re-released upstream. Fish were often observed holding immediately upstream of the traps or swimming in and out of the traps. Because one of the assumptions of mark recapture using DARR is that all fish released upstream survive and re-emigrate at the same rate as unmarked fish, this violation has the effect of artificially decreasing estimates of trap efficiency and increasing estimates of abundance. Because of this bias, that we suspect was especially high on Green Valley Creek, we only report minimum estimates of abundance and overwinter survival for Green Valley. Although we report abundance and overwinter survival estimates for Sheephouse Creek, we suspect that they are biased high and low, respectively.

At the Mill Creek trap, we were able to estimate weekly trap efficiencies using the PIT tagged fish and trap/antenna detections. For a given week, we divided the number of fish detected at both the trap and the antenna by the number detected at the antenna. Using this method, trap efficiency estimates ranged from 0.5 to 1.0 throughout the season with an overall efficiency of 0.87.

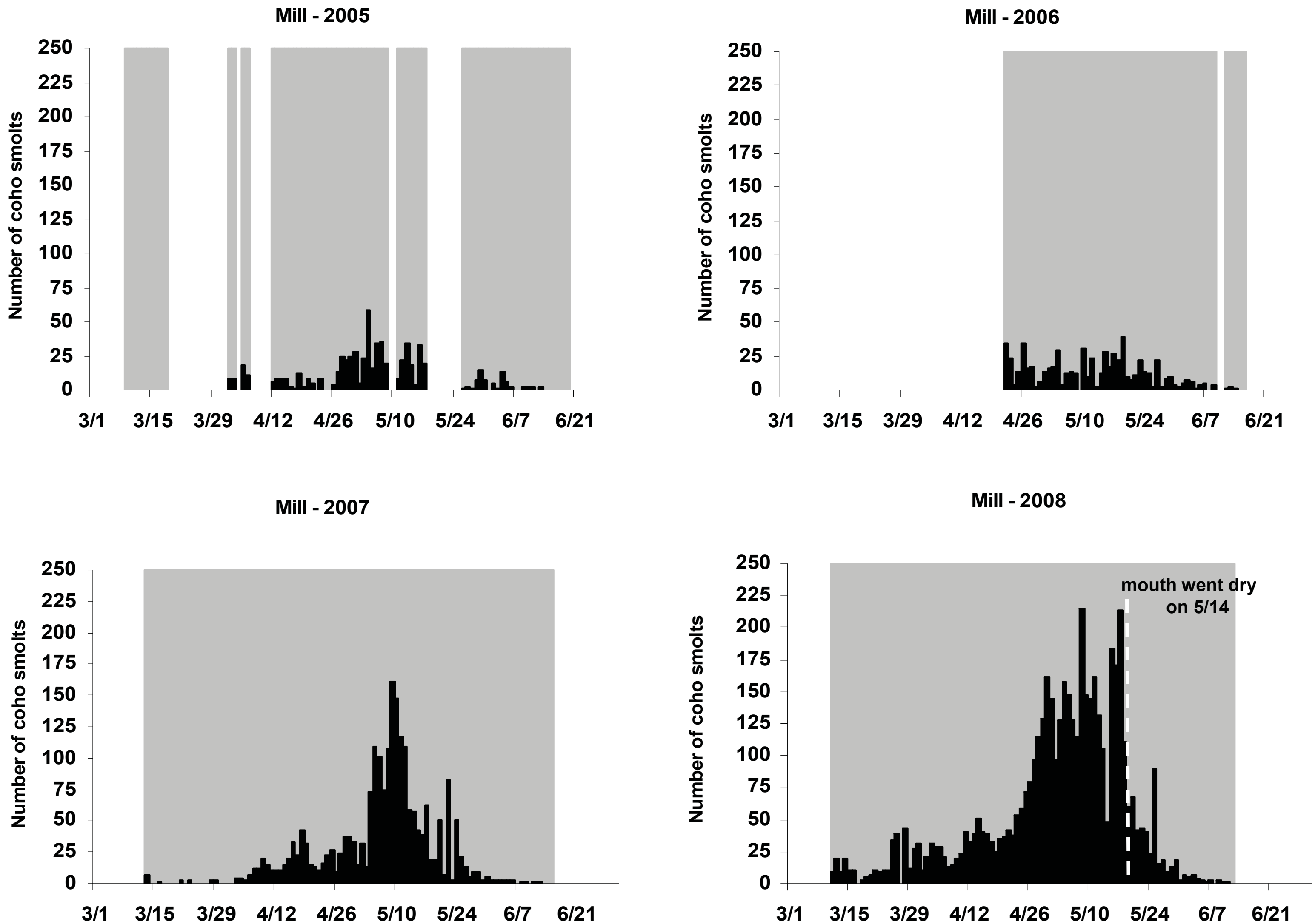

Figure 22. Number of smolts captured daily in downstream migrant traps, 2005-2008 in Russian River tributaries. Shaded background indicates days that the traps were fishing. Note that the scale is larger for Mill Creek.

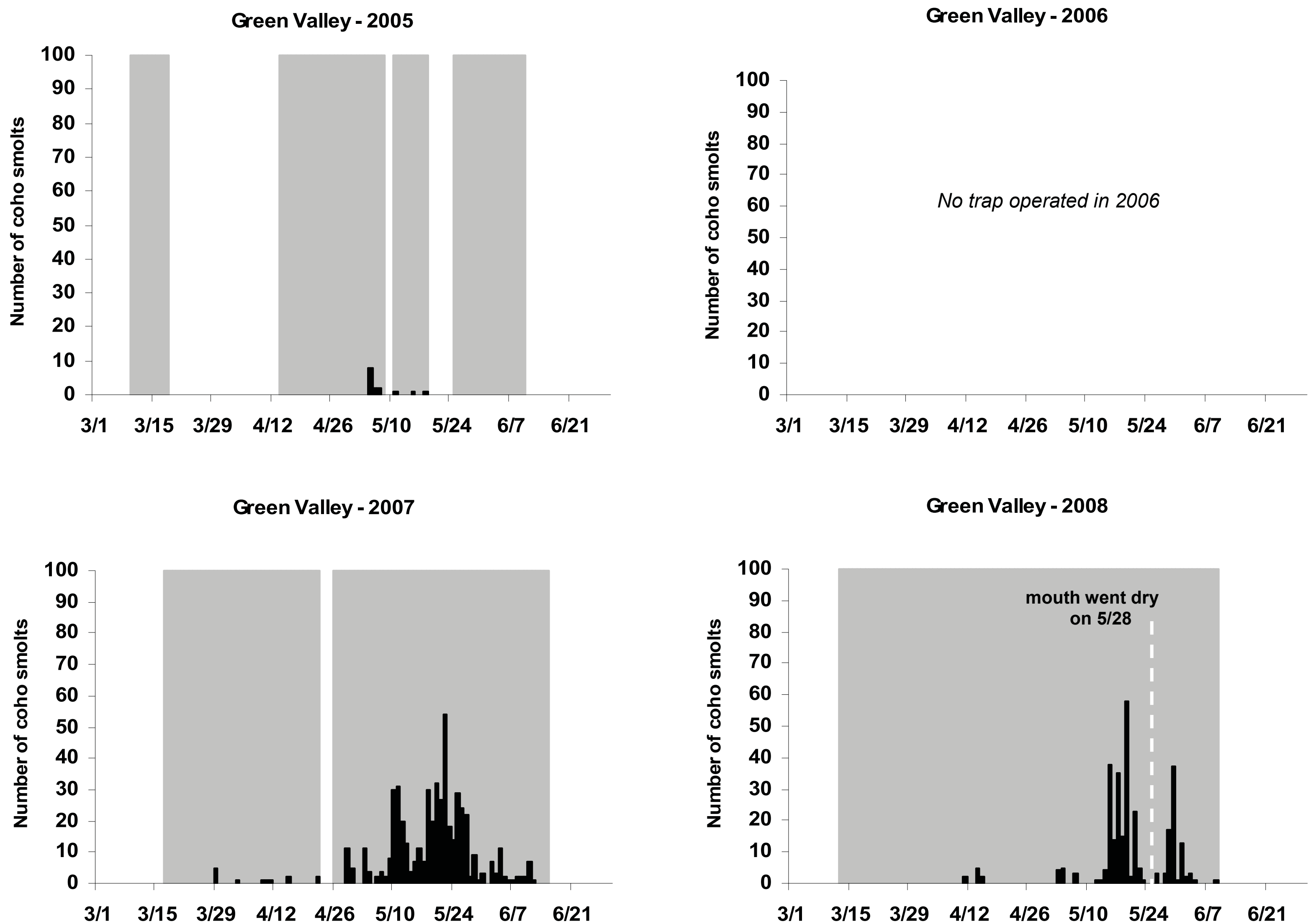

Figure 22 (*cont.*). Number of smolts captured daily in downstream migrant traps, 2005-2008 in Russian River tributaries. Shaded background indicates days that the traps were fishing. Note that the scale is larger for Mill Creek.

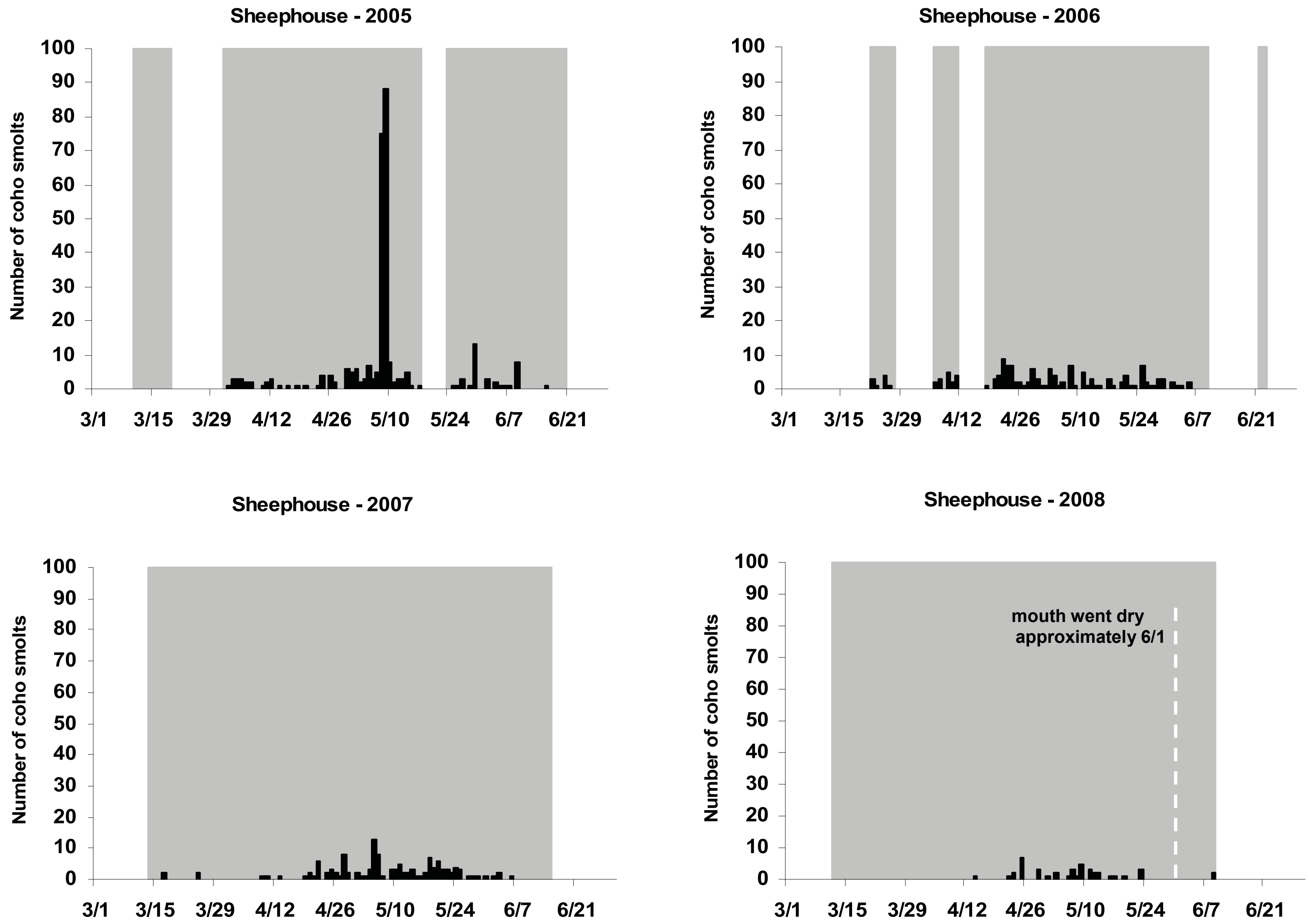

Figure 22 (*cont.*). Number of smolts captured daily in downstream migrant traps, 2005-2008 in Russian River tributaries. Shaded background indicates days that the traps were fishing. Note that the scale is larger for Mill Creek.

Coho abundance and overwinter survival estimates

In 2008, a greater number of smolts left the Mill Creek system than in previous years, and fewer smolts left Sheephouse and Green Valley Creeks (**Table 17**). The increased number of smolts leaving Mill Creek was a result of an increased number of fish released in the fall, rather than an increase in overwinter survival. On average, overall overwinter apparent survival estimates of spring and fall-released fish combined were lower in 2007-2008 compared to 2006-2007, and similar to those observed in 2005-2006 (**Table 17**). Although we were not able to estimate smolt abundance on Green Valley Creek, by comparing trap counts from 2007 and 2008, it is likely that overwinter survival was lower in 2008 than in 2007; minimum survival was 12% in 2007 and 4% in 2008. Sheephouse Creek had the highest estimate of overwinter survival in 2008. It is possible that the low fall densities allowed for higher survival, however, we suspect that the estimate is biased high due to low recapture rates caused by trap avoidance.

Because spring and fall-released coho have different overwinter survival rates, and spring and fall-released fish are stocked in different proportions in each creek, it may be more appropriate to compare data from only fall-released fish for among stream comparisons of overwinter apparent survival within each year (**Figure 23**).

Comparison of spring and fall release groups

In 2007, Mill and Palmer Creeks were stocked in both the spring and fall seasons and comparisons of overwinter survival were made between all four groups. To estimate overwinter survival for each release group, estimates of smolt abundance were compared to either the estimated number of spring stocked fish that survived until the time of the fall release (spring release group) or the number of fall stocked fish (fall release group). As in previous years, estimates of abundance and overwinter survival were higher for fall released fish in both streams (**Table 18**). In 2008, run timing of downstream migration began earlier for fall released fish, and the peak of the run appeared later for spring released fish (**Figure 24**).

Table 17. Smolt abundance and overwinter apparent survival estimates for coho juveniles released in 2004-2007.

Trap year	Tributary	Number spring stocked	Number fall stocked	Spring stocked remaining at fall release (95% CI)	Total number at time of fall release[1]	Trap Count [2]	Smolt abundance[3] (95% CI)	Overwinter apparent survival[4] (95% CI)
2005	Mill	0	3,433	0	3,433	632	1,907 (1,567 - 2,246)	0.56 (0.46 - 0.65)
2005	Sheephouse	0	952	0	952	294	415 (375 - 456)	0.44 (0.39 - 0.48)
2005	Ward	0	1,775	0	1,775	87	190 (145 - 234)	0.11 (0.08 - 0.13)
2006	Mill	0	4,399	0	4,399	384	776 (577-976)	0.18 (0.13-0.22)
2006	Palmer	2,466	1,920	1,022 (683-1,433)	2,942	260	526 (390-661)	0.18 (0.13-0.22)
2006	Sheephouse	7,024	1,070	3,277 (2,548-4,063)	4,347	137	288 (219-357)	0.07 (0.05-0.08)
2006	Ward	0	4,356	0	4,356	125	214 (182-247)	0.05 (0.04-0.06)
2007	Mill	5,297	6,302	422 (177-730) [5]	6,724	1,502	2,065 (1,865-2,265)	0.26 (0.23-0.28) [5]
2007	Palmer	2,102	3,021	1,004 (619-1,424)	4,025	660	907 (808-1,007)	0.23 (0.20-0.25)
2007	Sheephouse	2,911	978	1,992 (1,350-2,694)	2,970	123	238 (202-273)	0.08 (0.07-0.09)
2007	Ward	5,690	0	453 (191-810) [5]	453	128	183 (162-205)	*na* [5]
2007	Green Valley	0	4,278	0	4,278	504	1,397 (1,153-1,641)	0.33 (0.27-0.38)
2008	Mill	9,039	25,154	1,978 (1,436-2,562)	27,132	3,858	4,566 (4,187-4,946)	0.17 (0.15-0.18)
2008	Palmer	2,877	3,880	1,224 (951-1,510)	5,104	902	1,067 (978-1,155)	0.21 (0.19-0.23)
2008	Sheephouse	3,004	0	407 (296-535)	407	42	99 (82-116)	0.24 (0.20-0.28)
2008	Green Valley	0	7,883	0	7,883	299	299 (min est)	0.04 (min est)

[1] Sum of spring stocked fish that survived until time of fall release and number of fall stocked fish.

[2] Trap counts were adjusted to reflect CWT and VIE retention rates.

[3] In 2006 high spring stream flows did not allow for trap installation until late March (Sheephouse) or late April (Mill and Ward), therefore abundance estimates are likely biased low.

[4] Survival estimates include both spring and fall released coho. Survival estimates in 2006 are likely biased low because abundance estimates were likely biased low (see footnote 3).

[5] We suspect that the late summer abundance estimates for Mill and Ward Creeks in 2006 were biased low due to sampling design, and can be only considered minimum estimates. Because of this bias, we did not include spring released fish in overwinter survival calculations on Mill and Ward Creeks.

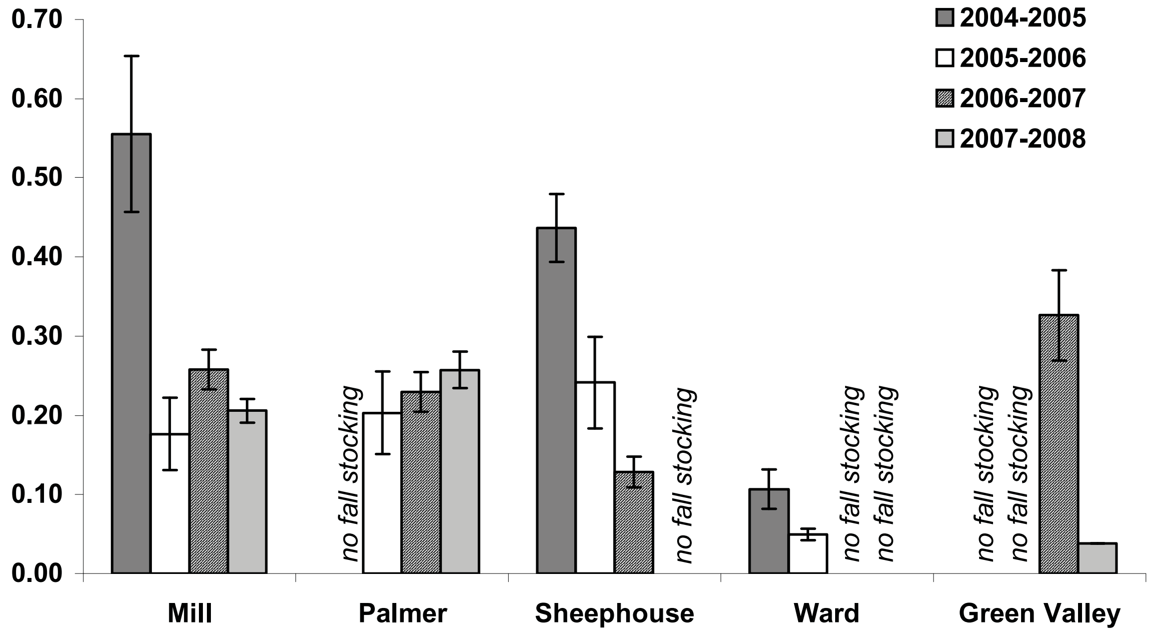

Figure 23. Overwinter apparent survival estimates for fall-released juvenile coho during the winters of 2004-2005 through 2007-2008.

Table 18. Estimated smolt abundance and overwinter apparent survival of spring and fall-stocked coho, 2006-2008.

Trap year	Tributary	Smolt abundance (95% CI)		Overwinter apparent survival (95% CI)	
		spring	*fall*	*spring*	*fall*
2006	Palmer	135 (101-170)	390 (290-491)	0.13 (0.10-0.17)	0.20 (0.15-0.26)
2006	Sheephouse	29 (22-36)	258 (196-320)	0.01 (0.01-0.01)	0.24 (0.18-0.30)
2007	Mill	439 (396-481)	1,627 (1,469-1,784)	*na* [1]	0.26 (0.23-0.28)
2007	Palmer	214 (191-238)	693 (617-769)	0.21 (0.19-0.24)	0.23 (0.20-0.25)
2007	Sheephouse	112 (95-129)	126 (107-145)	0.06 (0.05-0.06)	0.13 (0.11-0.15)
2008 [2]	Mill	201 (185-256)	4,365 (4,002-5,539)	0.12 (0.11-0.13)	0.21 (0.19-0.25)
2008 [2]	Palmer	253 (232-321)	814 (746-1,033)	0.12 (0.10-0.15)	0.26 (0.23-0.33)

[1] We suspect that the abundance estimate for 2006 spring released coho in Mill was biased low, therefore we did not calculate an overwinter survival estimate.

[2] In 2008 total abundance estimates for each release group were estimated using CWT data, however, due to the high rate of misclassification of CWT locations, overwinter survival estimates for release season comparisons were calculated using data from spring and fall PIT tag releases only.

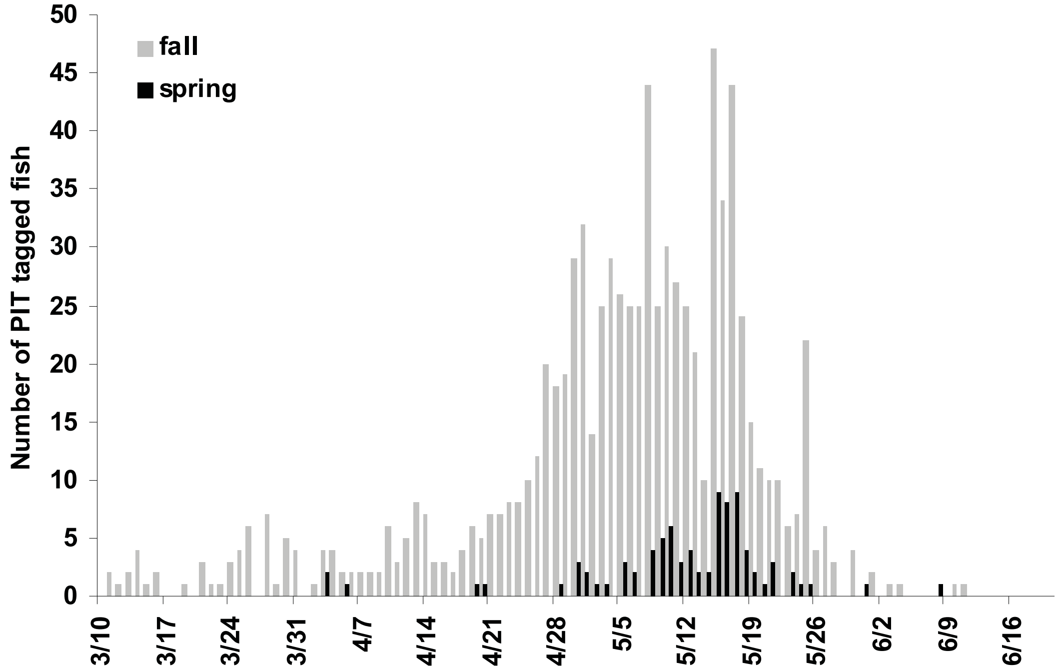

Figure 24. Number of spring and fall-released PIT tagged coho stocked into tributaries of the Russian River and captured in downstream migrant traps each day during spring 2008.

Size and condition

In 2008, average fork length and weight of fall-released smolts captured in Green Valley was higher than in all other creeks, similar to what was observed in 2007 (**Figure 25**, **Table 19).** Average fork lengths and weights in Mill, Palmer, and Sheephouse Creeks were similar, with Mill smolts having only slightly larger size than smolts in the other two creeks. Smolt size was similar between spring and fall release groups, with spring-released fish having slightly smaller average size than fall-released fish. Condition factor varied by stream; Palmer spring release smolts had the highest average condition factor, and Green Valley smolts the lowest. Condition factor varied more extremely by release group; spring-released fish had significantly higher condition factor than fall-released fish. This suggests that the fall-released fish were further developed as smolts when passing through the downstream migrant traps. On average, smolt size in 2008 was larger than in 2007, but smaller than in 2005 and 2006. On average, mean sizes of smolts captured in Mill, Palmer, and Sheephouse Creeks are comparable to sizes observed for wild fish in Olema, Redwood, Pine Gulch, and Upper Lagunitas Creeks, and mean sizes of Green Valley smolts are comparable to values observed in San Geronimo and Lower Lagunitas Creeks (Reichmuth, et. al. 2006).

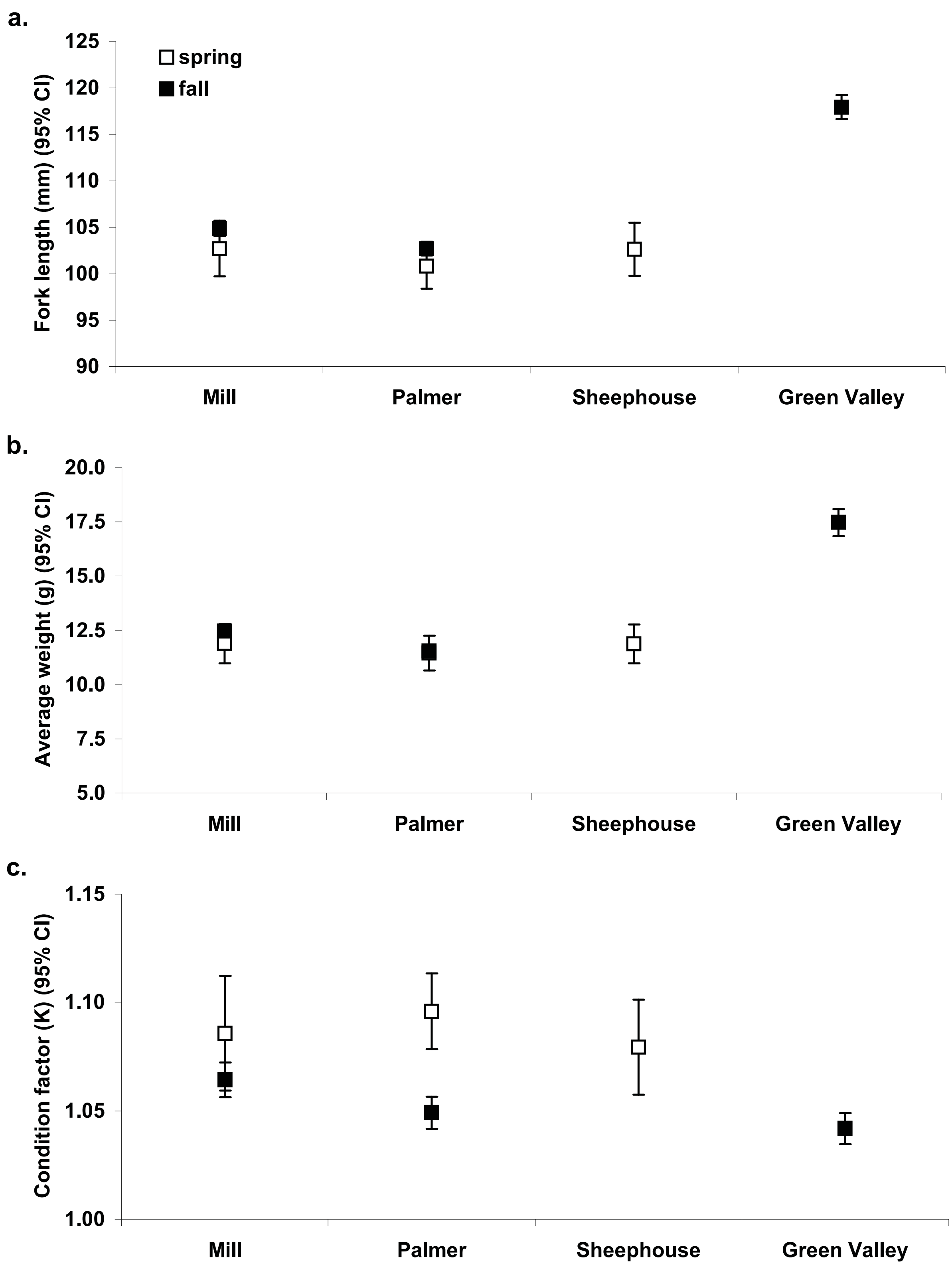

Figure 25. Mean fork length (a), weight (b), and condition factor (c) of coho smolts released in spring or fall 2006 and captured in downstream migrant traps, spring 2008.

Table 19. Mean fork length (FL) and weight (WT) of spring and fall coho release groups in the fall prior to outmigration and during smolt outmigration.

Trap year	Tributary	Sample Date	Size in fall age-0+ (95% CI)						Size in spring age-1+ (95%CI)					
			spring group [1]			*fall group* [2]			*spring group*			*fall group*		
			n	FL (mm)	WT (g)	n	FL (mm)	WT (g)	n	FL (mm)	WT (g)	n	FL (mm)	WT (g)
2005	Mill	10/01/04	0	*NA*	*NA*	125	100.1 (+/-2.9)	13.5 (+/-1.2)	0	*NA*	*NA*	576	118.0 (+/-0.9)	16.8 (+/-0.4)
2005	Sheephouse	10/08/04	0	*NA*	*NA*	100	110.4 (+/-4.0)	18.8 (+/-2.1)	0	*NA*	*NA*	255	118.6 (+/-1.3)	16.8 (+/-0.5)
2005	Ward	10/01/04	0	*NA*	*NA*	100	100.7 (+/-3.2)	14.2 (+/-1.4)	0	*NA*	*NA*	87	111.1 (+/-2.1)	13.7 (+/-0.8)
2006	Mill	10/15/05	0	*NA*	*NA*	99	85.9 (+/-2.3)	8.3 (+/-0.7)	0	*NA*	*NA*	354	108.9 (+/-1.0)	14.1 (+/-0.4)
2006	Palmer	10/15/05	-	74.0	4.29	50	87.7 (+/-3.3)	9.0 (+/-1.1)	64	94.9 (+/-1.6)	10.0 (+/-0.5)	180	111.2 (+/-1.5)	15.3 (+/-0.6)
2006	Sheephouse	10/15/05	-	72.6	4.37	50	97.4 (+/-3.9)	12.2 (+/-1.4)	13	100.7 (+/-4.6)	11.0 (+/-1.5)	117	112.2 (+/-1.8)	15.0 (+/-0.8)
2006	Ward	10/15/05	0	*NA*	*NA*	100	85.9 (+/-2.6)	8.4 (+/-0.7)	0	*NA*	*NA*	120	103.0 (+/-1.7)	12.1 (+/-0.6)
2006	Gray	10/15/05	-	72.2	4.31	50	87.9 (+/-2.7)	8.2 (+/-0.7)	13	101.0 (+/-3.4) [3]	-	38	107.5 (+/-2.1) [3]	-
2007	Mill	10/06/06	-	74.2	4.90	200	75.3 (+/-0.8)	5.1 (+/-0.2)	243	99.0 (+/-1.0)	10.8 (+/-0.3)	621	99.5 (+/-0.6)	10.8 (+/-0.2)
2007	Palmer	10/06/06	-	66.1	3.25	100	71.5 (+/-1.5)	4.6 (+/-0.3)	117	97.8 (+/-1.5)	10.3 (+/-0.4)	233	97.4 (+/-0.9)	10.2 (+/-0.3)
2007	Sheephouse	10/06/06	-	70.5	3.87	50	73.6 (+/-1.3)	4.9 (+/-0.3)	53	99.8 (+/-2.3)	10.9 (+/-0.8)	58	96.0 (+/-2.3)	9.9 (+/-0.8)
2007	Ward	10/06/06	-	72.0	4.01	0	*NA*	*NA*	119	93.5 (+/-1.5)	8.9 (+/-0.4)	0	*NA*	*NA*
2007	Gray	10/06/06	-	67.6	3.23	100	72.5 (+/-1.0)	4.4 (+/-0.2)	0	*NA*	*NA*	0	*NA*	*NA*
2007	Green Valley	10/06/06	0	*NA*	*NA*	100	73.8 (+/-1.0)	4.7 (+/-0.2)	0	*NA*	*NA*	487	112.7 (+/-0.9)	16.1 (+/-0.4)
2007	Dutch Bill	10/06/06	0	*NA*	*NA*	150	74.5 (+/-1.0)	5.1 (0.2)	0	*NA*	*NA*	0	*NA*	*NA*
2008	Mill	10/24/07		68.5	3.35	200	86.4 (+/-1.5)	8.0 (+/-0.4)	29	102.7 (+/-3.0)	11.9 (+/-0.9)	379	104.9 (+/-0.8)	12.5 (+/-0.3)
2008	Palmer	10/22/07		65.9	2.9	200	86.8 (+/-1.4)	8.0 (+/-0.4)	51	100.8 (+/-2.4)	11.5 (+/-2.9)	454	102.7 (+/-0.7)	11.5 (+/-2.7)
2008	Sheephouse	10/15/07		69	3.63	0	*NA*	*NA*	42	102.6 (+/-2.9)	11.9 (+/-0.9)	0	*NA*	*NA*
2008	Gray	10/15/07		61.7	2.23	100	85.4 (+/-1.3)	7.2 (+/-0.3)	0	*NA*	*NA*	0	*NA*	*NA*
2008	Gilliam	10/15/07		*NA*	*NA*	50	89.4 (+/-1.6)	8.2 (+/-0.5)	0	*NA*	*NA*	0	*NA*	*NA*
2008	Green Valley	10/15/07		*NA*	*NA*	150	89.9 (+/-1.2)	8.7 (+/-0.4)	0	*NA*	*NA*	241	117.9 (+/-1.3)	17.5 (+/-0.6)
2008	Dutch Bill	10/31/07		*NA*	*NA*	150	84.9 (+/-1.5)	7.5 (+/-0.4)	0	*NA*	*NA*	0	*NA*	*NA*

[1] Sizes for spring-released fish in fall are predicted based on estimated oversummer growth rates.

[2] Size data was collected by Warm Springs Hatchery staff 3 to 27 days (Oct-Nov) prior to fall stocking.

[3] Data collected by Austin Creek trapping effort (Katz et. al. 2006).

Other species

Although not targeted for capture, a number of other native and non-native fish, amphibians, crustaceans and other species were also captured in our downstream migrant traps (**Table** 20-**Table 22).**

Table 20. Non-salmonid fish species captured in downstream migrant traps, 2005-2008.

		Native fish species											Non-native fish species								
Year	Tributary	hardhead	Lamprey spp.[1]	Pacific lamprey[2]	Sacramento pikeminnow	roach	Sacramento sucker	Sculpin spp.	three-spined stickleback	tule perch	Western brook lamprey	Sacramento blackfish	black bullhead	bluegill	fathead minnow	golden shiner	green sunfish	largemouth bass	mosquitofish	smallmouth bass	white crappie
2005	Mill	45	48	8	29	110	100	895	0	0	3	0	0	54	22	0	35	6	0	2	2
2005	Sheephouse	18	0	0	44	36	98	1,635	1	0	0	0	0	0	0	0	0	0	0	0	0
2005	Ward	6	0	1	0	59	4	866	4	0	0	0	0	0	0	0	0	0	0	0	0
2005	Green Valley	147	32	0	62	211	53	371	1,699	3	5	3	3	627	15	0	40	1	0	0	13
2006	Mill	13	61	10	27	65	38	4,066	0	0	3	0	0	11	13	0	5	0	0	0	0
2006	Sheephouse	9	0	0	119	23	34	2,056	0	0	0	0	0	0	2	0	0	0	0	0	0
2006	Ward	1	0	0	0	33	0	3,034	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Mill	28	222	9	12	84	38	414	0	0	7	0	0	1	13	0	1	0	0	0	0
2007	Sheephouse	8	0	0	19	2	13	286	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	Ward	4	0	2	1	47	13	1,051	10	0	0	0	0	0	0	0	0	0	0	0	0
2007	Green Valley	164	23	2	104	497	79	474	253	27	5	0	3	68	14	20	4	0	3	0	14
2008	Mill	2	129	2	16	60	89	704	0	0	9	0	0	2	6	0	0	0	0	0	0
2008	Sheephouse	1	0	0	81	12	35	2,954	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	Green Valley	19	12	3	95	498	178	370	1,498	1	44	0	1	21	0	4	0	2	0	0	4

[1]Lamprey spp. refers to uneyed ammocoetes that we could not identify to species.

[2]Pacific lamprey refer to adults. Adults were observed both as appearing silver/blue (presumed unspawned) and brown/scarred (presumed spawned-out).

Table 21. Amphibian species captured in downstream migrant traps, 2005 to 2008.

		Native										Non-native	
Year	Tributary	CA giant salamander	Foothill yellow-legged frog	Oregon ensatina [1]	Pacific tree frog	red-bellied newt [1]	rough-skinned newt	Speckled black salamander [1]	unknown frog	unknown tadpoles	Western toad	bullfrog	bullfrog tadpoles
2005	Mill	0	0	0	0	0	0	0	33	111	8	13	653
2005	Sheephouse	0	0	0	0	0	0	0	2	0	0	0	0
2005	Ward	0	126	0	0	0	0	0	10	0	0	0	0
2005	Green Valley	0	0	0	3	0	19	0	14	34	51	5	5
2006	Mill	4	5	0	0	0	0	1	0	0	5	10	10
2006	Sheephouse	0	0	0	0	0	0	0	0	0	0	0	0
2006	Ward	2	168	1	0	0	0	0	0	0	1	7	0
2007	Mill	1	7	0	0	0	0	0	0	0	6	16	11
2007	Sheephouse	0	0	0	0	0	0	0	0	0	0	0	0
2007	Ward	1	231	1	0	1	2	0	0	0	3	4	0
2007	Green Valley	5	0	0	0	0	23	0	0	3	64	6	36
2008	Mill	7	14	3	1	3	0	2	0	0	5	7	45
2008	Sheephouse	0	1	0	0	1	0	0	0	0	0	0	0
2008	Green Valley	0	1	0	0	1	6	0	0	2	80	3	4

[1]Non-aquatic species

Table 22. Non-fish and non-amphibian species captured in downstream migrant traps, 2005-2008.

Year	Tributary	CA freshwater shrimp	Common merganser	mallard	muskrat	Red-eared slider turtle	unknown turtle sp.	unknown crayfish	unknown duckling	Northern Pacific pond turtle [1]	Wood duck
2005	Mill	0	4	11	0	0	1	1	0	0	0
2005	Sheephouse	0	0	0	0	0	0	0	0	0	0
2005	Ward	0	0	0	0	0	0	22	2	0	0
2005	Green Valley	8	0	3	0	1	1	60	0	2	0
2006	Mill	0	5	7	0	0	0	36	0	0	0
2006	Sheephouse	0	0	0	0	0	0	4	0	0	0
2006	Ward	0	11	0	0	0	0	50	0	0	0
2007	Mill	0	0	0	0	0	0	17	0	1	0
2007	Sheephouse	0	0	0	0	0	0	7	0	0	0
2007	Ward	0	0	0	0	0	0	36	0	0	0
2007	Green Valley	0	0	0	3	1	0	173	0	4	0
2008	Mill	0	7	9	2	0	1	33	6	1	0
2008	Sheephouse	0	0	0	0	0	0	4	1	0	0
2008	Green Valley	1	0	0	3	0	0	61	3	1	17

[1] Formerly known as the Western Pond Turtle.

Genetics samples

Genetics samples were collected on 1,050 program coho smolts, one wild coho smolt (from Mill Creek), 140 wild steelhead (136 smolts, two parr and two adults) and two hatchery steelhead smolts. These samples will be delivered to Carlos Garza at the Southwest Fisheries Science Center, NOAA Fisheries, Santa Cruz, CA where they will be processed and analyzed.

Mortalities

Measures were taken to minimize mortality of salmonids captured in the downstream migrant traps, including frequent (at least once daily) checking of traps and removal of debris, installation of flow deflectors inside of the box to provide relief from the current, and removal of the traps during high-flow events. Despite these efforts, mortality of salmonids at various life stages occurred (**Table 23**). The majority of coho smolt mortalities for 2008 occurred on an extreme low flow, high temperature fluctuation event on Mill Creek on 5/15. At this time, the mouth of Mill Creek dried and all fish captured after this date were placed in coolers and transported to Dry Creek for release. Four adult steelhead carcasses were found in downstream migrant trap boxes this year; three were highly degraded carcasses and the other had a large wound on its side. We suspect that these fish died prior to entering the trap box.

Table 23. Percentage and number of salmonid mortalities observed during operation of downstream migrant trapping, 2005-2008.

		Coho		Steelhead			Chinook
Year	Tributary	yoy	smolt	yoy/parr	smolt	adult	yoy
2005	Mill	25% (6/24)	0.9% (6/634)	0.1% (1/1904)	1.0% (1/103)	33.3% (3/9)	1.4% (1/70)
2005	Sheephouse	0% (0/3348)	1.4% (4/294)	0.8% (1/123)	0% (0/15)	na	0% (0/2)
2005	Ward	0% (0/1)	0% (0/87)	0.3% (2/668)	0% (0/5)	0% (0/1)	na
2005	Green Valley	na[1]	6.7% (1/15)	0.1% (1/1723)	2.0% (1/49)	0% (0/1)	0.5% (5/925)
2006	Mill	33.3% (1/3)	3.6% (23/646)	0.5% (2/438)	2.0% (1/49)	0% (0/5)	0.8% (1/128)
2006	Sheephouse	na	0% (0/141)	0% (0/80)	0% (0/17)	na	na
2006	Ward	na	2.4% (3/125)	3.3% (12/363)	0% (0/25)	0% (0/2)	na
2007	Mill	0% (0/58)	0.2% (5/2963)	0% (0/931)	0% (0/266)	0% (0/31)	0% (0/2)
2007	Sheephouse	na	1.0% (2/191)	2% (1/50)	0% (0/18)	0% (0/1)	na
2007	Ward	na	0% (0/216)	0.3% (2/707)	0% (0/53)	0% (0/20)	na
2007	Green Valley	na	2.2% (14/625)	0% (0/35)	1.4% (1/70)	0% (0/8)	2.7% (6/226)
2008	Mill	0% (0/43)	1.0% (49/4804)	0.8% (34/4108)	1.3% (2/158)	20% (3/15)[1]	0% (0/31)
2008	Sheephouse	na	0% (0/42)	0% (0/18)	0% (0/5)	na	na
2008	Green Valley	na	1.3% (4/299)	2.9% (15/515)	3.4% (1/29)	100% (1/1)[1]	0.5% (2/40)

na = no fish of a particular species or life history were captured

[1] Of the four steelhead adult mortalities, three were highly degraded carcasses and another had a large wound on its side.

TEMPERATURE COMPARISONS

Temperature data was collected on coho program streams in order to document and compare patterns in temperature among stocking streams, and between stocking streams and comparison streams that sustain wild coho populations.

Methods

Onset Hobo Temp or Optic StowAway loggers were deployed at various sites in Mill, Palmer, Felta, Wallace, Sheephouse, Ward, Gray, Green Valley, and Dutch Bill Creeks (**Figure 26-31**). During the summer, temperature loggers were deployed in multiple reaches on each stream (between two and five loggers per stream), with the exception of Wallace and Felta which received one logger per stream. Temperature was recorded hourly at each station. This distribution of loggers enabled within-stream temperature comparisons during the summer survival period. Temperature loggers were deployed in the spring (April-June) and removed in the fall (October-November). Stream audits were performed three times over the summer season to download data and check that the instrumentation was submerged and functioning properly. At the downstream temperature (and stage height) recording stations on Mill, Sheephouse, Ward, Green Valley, and Dutch Bill Creeks, temperature loggers were left in the streams year-round to record hourly temperature during all seasons.

Results

In general, average stream temperatures between 6/15 and 10/15 in 2007 were higher than 2005 averages and lower than 2006 averages, with some variability among streams (**Table 24**). For example, within Dutch Bill Creek at site RR-DUT-10.55, the overall mean and maximum temperatures were 13.37 and 17.10°C in 2005, respectively. This is compared to 13.99 and 18.71°C in 2006, respectively, and 13.6 and 16.01°C in 2007, respectively. At all stream sites where data was collected in consecutive years from 2005 to 2007, maximum weekly average and maximum weekly maximum temperatures between 6/15 and 10/15 in 2007 were similar to values in 2005 and lower than values in 2006 (**Figure 32**).

In addition to annual variability, stream temperatures generally warmed in the downstream direction. Comparing Ward Creek sites RR-WAR-4.03, furthest upstream, and RR-WAR-0.06, furthest downstream demonstrates this dynamic. In 2005 the upstream maximum weekly average temperature (MWAT) was 17.52°C compared with 20.23°C downstream. Similarly, in 2006 the MWAT was 20.04°C upstream and 21.92°C downstream, and in 2007, 16.37°C upstream and 19.73°C downstream. This trend was not consistent in Mill Creek, and we suspect that this is related to the influence of cooler tributaries and ground water entering at various locations along the stream course.

In addition to annual and within-stream variation in temperature, we also observed variation among program streams in 2007 (**Figure 33**). In order to compare oversummer temperature among spring-release streams, a temperature monitoring site within the stocking reach was chosen for each stream. These sites were also chosen based on continuity of data collection since 2005 but are not necessarily consistent with respect to location in the stocking reach (e.g. Palmer site was high in the stocking reach, Ward was in the middle of the stocking reach). Despite these potential biases, consistently cooler running weekly average temperatures and running weekly maximum temperatures were observed each year in Sheephouse Creek compared with other program streams throughout the summer months (**Table 24**, **Figure 33**). Temperatures in Palmer Creek were also relatively cooler than in other streams, and temperatures were often highest at specific sites in Mill and Ward Creeks.

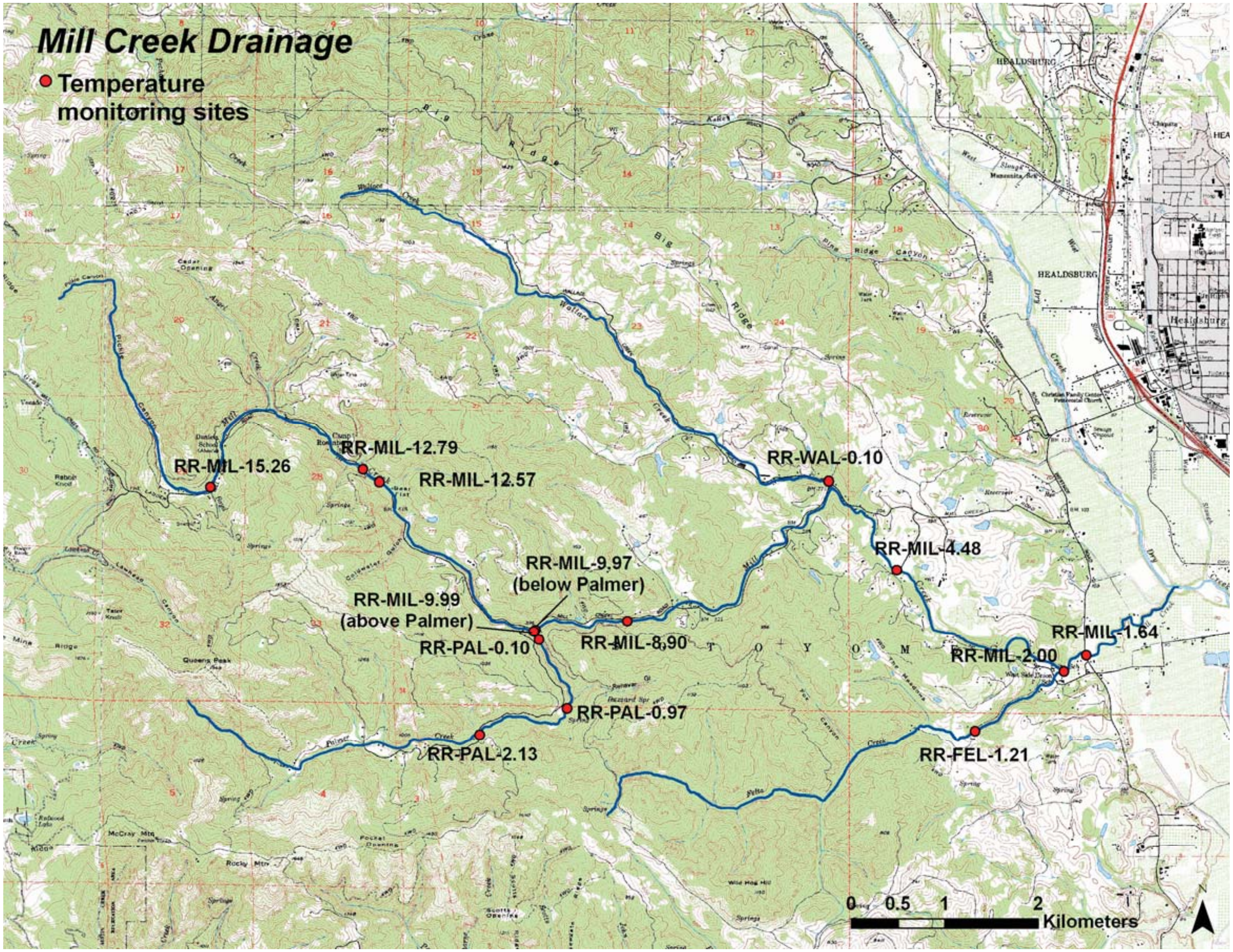

Figure 26. Temperature monitoring sites on Mill, Felta, Wallace, and Palmer Creeks, 2005, 2006, and 2007.

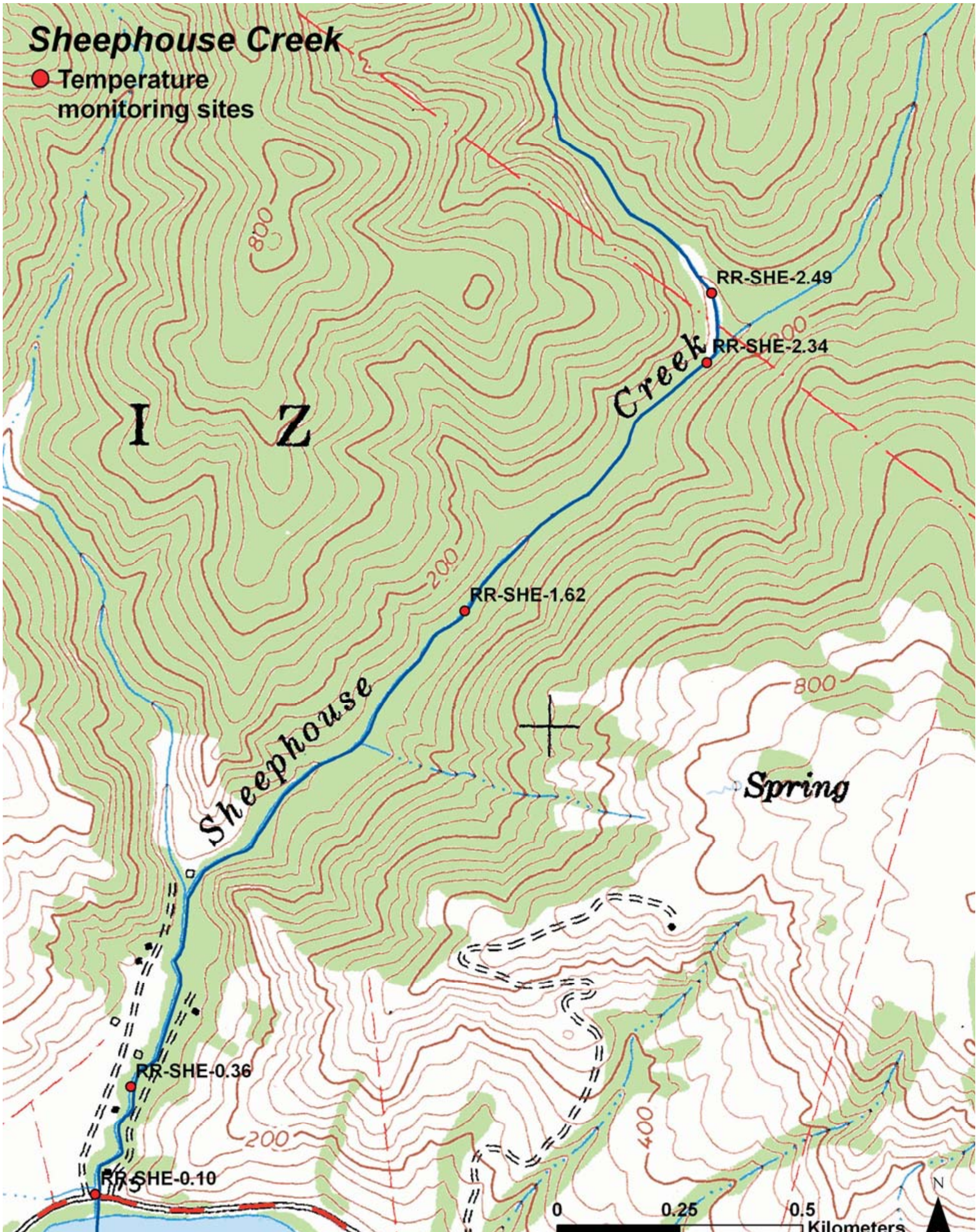

Figure 27. Temperature monitoring sites on Sheephouse Creek, 2005, 2006, and 2007.

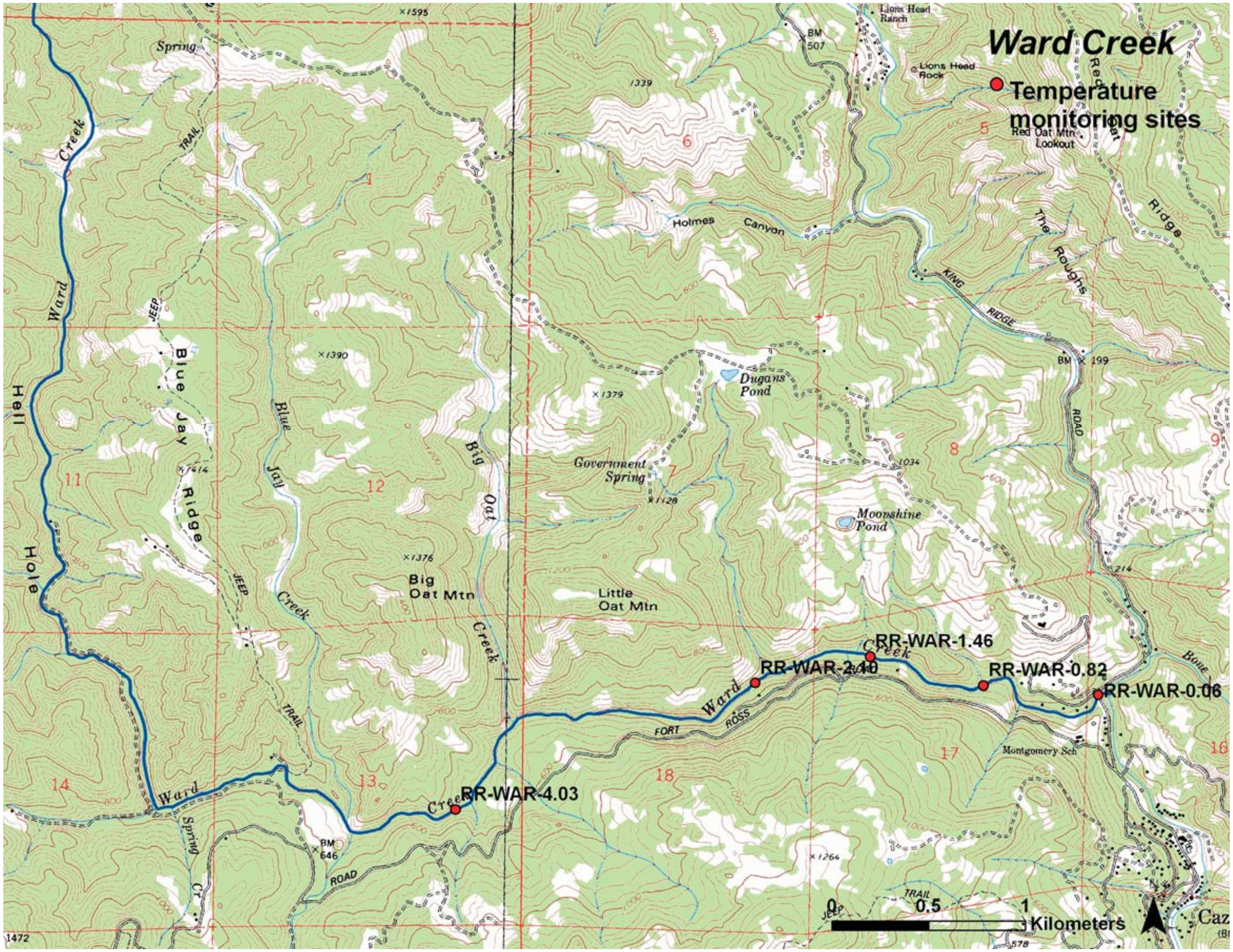

Figure 28. Temperature monitoring sites on Ward Creek, 2005, 2006, and 2007.

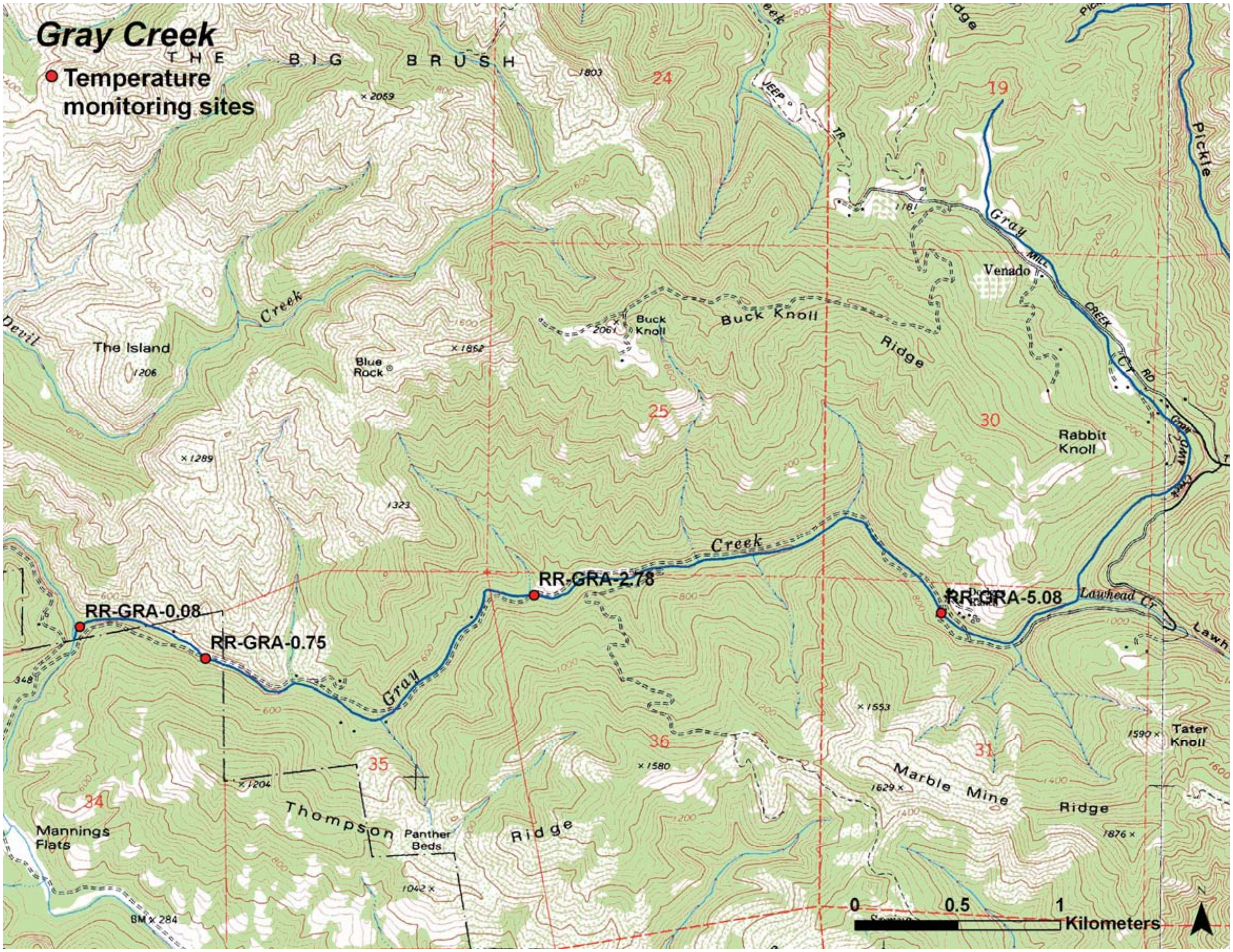

Figure 29. Temperature monitoring sites on Gray Creek, 2005, 2006, and 2007.

Figure 30. Temperature monitoring sites on Green Valley Creek, 2005, 2006, and 2007.

Figure 31. Temperature monitoring sites on Dutch Bill Creek, 2005, 2006, and 2007.

Table 24. Summary of temperature data collected between June 15 and October 15 at various sites on Russian River tributaries, 2005, 2006, and 2007. MWAT was calculated as the maximum running weekly average temperature between the start and end dates. MWMT was calculated as the maximum running weekly maximum temperature between the start and end dates.

Year	Tributary	Site	Start Date	End Date	Comments	Temperature (°C)				
						Mean	Min	Max	MWAT	MWMT
2005	Mill	RR-MIL-9.99	6/15/05	10/15/05		14.88	10.20	20.50	17.85	20.11
2005	Mill	RR-MIL-12.79	6/15/05	10/15/05		14.84	10.70	19.37	17.42	19.05
2005	Mill	RR-MIL-15.26	6/15/05	8/5/05	no data after 8/5	15.98	12.10	18.60	17.27	18.43
2005	Palmer	RR-PAL-0.10	6/15/05	10/15/05		14.75	10.18	19.32	17.74	18.94
2005	Palmer	RR-PAL-0.97	6/15/05	10/15/05		14.79	10.14	19.30	17.71	18.90
2005	Palmer	RR-PAL-2.13	6/15/05	10/15/05		14.57	10.41	18.73	17.17	18.38
2005	Sheephouse	RR-SHE-0.10	6/15/05	10/15/05		13.54	11.18	16.94	14.52	15.91
2005	Sheephouse	RR-SHE-1.62	6/15/05	10/15/05		12.50	9.31	14.89	13.92	14.38
2005	Sheephouse	RR-SHE-2.49	6/15/05	10/15/05		12.28	9.42	15.23	13.76	14.47
2005	Ward	RR-WAR-0.06	6/15/05	10/8/05		17.19	11.82	21.94	20.23	21.75
2005	Ward	RR-WAR-4.03	6/15/05	10/15/05		14.93	10.07	19.34	17.52	19.04
2005	Gray	RR-GRA-2.78	6/21/05	10/15/05	No data 9/6 - 9/26	15.19	10.90	19.40	17.45	19.29
2005	Gray	RR-GRA-5.08	6/21/05	10/15/05		14.98	10.99	19.42	17.51	19.04
2005	GreenValley	RR-GRE-2.14	6/15/05	10/15/05		16.42	11.70	20.50	19.29	20.20
2005	GreenValley	RR-GRE-12.49	6/15/05	10/15/05		15.00	10.11	19.80	17.76	19.40
2005	GreenValley	RR-GRE-13.69	6/15/05	8/25/05		16.41	13.22	19.58	18.10	19.13
2005	GreenValley	RR-GRE-13.88	6/15/05	10/15/05		15.22	11.70	19.40	17.67	18.94
2005	Dutch Bill	RR-DUT-10.55	6/15/05	10/15/05		13.37	10.20	17.10	15.32	16.47
2006	Mill	RR-MIL-1.64	6/15/06	10/6/06		16.39	6.26	22.88	19.35	22.18
2006	Mill	RR-MIL-2.00	6/15/06	10/15/06		16.09	6.38	23.66	20.22	22.53
2006	Mill	RR-MIL-4.48	6/15/06	10/15/06		17.03	11.65	25.08	21.71	23.70
2006	Mill	RR-MIL-9.97	6/15/06	10/15/06		15.66	10.24	23.18	20.38	22.39
2006	Mill	RR-MIL-12.79	6/15/06	10/15/06		15.21	10.53	21.47	19.25	20.88
2006	Palmer	RR-PAL-0.10	6/15/06	10/15/06		15.42	10.34	22.10	20.10	21.37
2006	Palmer	RR-PAL-2.13	6/15/06	10/15/06		15.08	10.28	21.52	19.49	20.80
2006	Wallace	RR-WAL-0.10	6/15/06	10/15/06		15.30	11.32	20.17	18.27	19.11

Table 24 (*cont*). Summary of temperature data collected between June 15 and October 15 at various sites on Russian River tributaries, 2005, 2006, and 2007. MWAT was calculated as the maximum running weekly average temperature between the start and end dates. MWMT was calculated as the maximum running weekly maximum temperature between the start and end dates.

						Temperature (°C)				
Year	Tributary	Site	Start Date	End Date	Comments	Mean	Min	Max	MWAT	MWMT
2006	Felta	RR-FEL-1.21	6/15/06	10/15/06		15.97	11.78	22.64	20.23	21.48
2006	Sheephouse	RR-SHE-0.36	6/15/06	10/9/06		13.10	10.60	15.32	14.63	15.12
2006	Sheephouse	RR-SHE-2.34	6/15/06	10/15/06		12.73	9.80	16.04	14.91	15.52
2006	Ward	RR-WAR-0.06	6/15/06	10/15/06		16.97	10.57	25.76	21.92	24.44
2006	Ward	RR-WAR-0.82	6/15/06	10/15/06		16.82	11.16	24.16	21.78	23.09
2006	Ward	RR-WAR-1.46	6/15/06	10/15/06		16.76	10.39	25.71	21.83	24.77
2006	Ward	RR-WAR-2.10	6/15/06	10/15/06		16.21	9.92	25.42	21.38	24.26
2006	Ward	RR-WAR-4.03	6/15/06	10/15/06		15.51	10.09	22.65	20.04	21.65
2006	Gray	RR-GRA-0.08	6/15/06	10/15/06		16.32	10.54	24.20	20.94	23.32
2006	Gray	RR-GRA-0.75	6/15/06	10/15/06		15.53	9.82	22.48	20.13	21.66
2006	Gray	RR-GRA-2.78	6/15/06	10/15/06		16.00	11.17	22.66	20.17	21.85
2006	Gray	RR-GRA-5.08	6/15/06	10/15/06		15.50	11.33	22.16	20.00	21.40
2006	GreenValley	RR-GRE-2.14	6/15/06	10/12/06		17.52	5.75	25.93	22.06	24.64
2006	GreenValley	RR-GRE-12.49	6/15/06	10/12/06		16.31	11.49	22.65	20.27	21.87
2006	GreenValley	RR-GRE-13.88	6/15/06	10/12/06		16.39	12.41	22.82	20.31	21.71
2006	Dutch Bill	RR-DUT-2.87	6/15/06	10/10/06		15.86	6.37	22.67	18.38	22.00
2006	Dutch Bill	RR-DUT-6.28	6/15/06	10/10/06		15.60	10.55	22.16	19.66	21.05
2006	Dutch Bill	RR-DUT-10.55	6/15/06	10/10/06		13.99	10.71	18.71	16.67	17.55
2007	Mill	RR-MIL-4.48	6/15/07	9/7/07	PIT reach, dewatered	18.50	14.27	24.52	19.89	23.56
2007	Mill	RR-MIL-8.90	6/25/07	10/15/07	PIT reach	15.83	10.08	21.00	18.51	19.81
2007	Mill	RR-MIL-9.97	6/15/07	10/15/07		15.53	9.29	21.79	18.16	20.43
2007	Mill	RR-MIL-12.57	6/25/07	10/15/07	PIT reach	14.95	10.11	18.24	16.95	17.53
2007	Mill	RR-MIL-12.79	6/15/07	10/15/07		15.40	9.46	20.34	17.57	19.09
2007	Palmer	RR-PAL-0.10	6/15/07	10/15/07		14.74	9.50	18.59	16.71	17.51
2007	Palmer	RR-PAL-2.13	6/15/07	10/15/07		15.13	9.31	20.01	17.33	18.80
2007	Wallace	RR-WAL-0.10	6/15/07	10/15/07		14.75	9.92	17.42	16.42	16.85

Table 24 (*cont*). Summary of temperature data collected between June 15 and October 15 at various sites on Russian River tributaries, 2005, 2006, and 2007. MWAT was calculated as the maximum running weekly average temperature between the start and end dates. MWMT was calculated as the maximum running weekly maximum temperature between the start and end dates.

						Temperature (°C)				
Year	**Tributary**	**Site**	**Start Date**	**End Date**	**Comments**	**Mean**	**Min**	**Max**	**MWAT**	**MWMT**
2007	Felta	RR-FEL-1.21	6/15/07	10/15/07		15.28	7.76	20.17	17.30	19.63
2007	Sheephouse	RR-SHE-0.36	6/15/07	10/10/07		12.95	5.86	19.42	14.21	16.72
2007	Sheephouse	RR-SHE-2.34	6/15/07	10/15/07		12.59	9.02	15.38	14.20	14.84
2007	Ward	RR-WAR-0.06	6/15/07	10/15/07		16.91	9.31	23.86	19.73	22.21
2007	Ward	RR-WAR-4.03	6/15/07	10/15/07		14.37	9.17	17.77	16.37	16.88
2007	Gray	RR-GRA-0.08	6/15/07	10/15/07		16.72	10.49	22.17	19.16	21.17
2007	Gray	RR-GRA-0.75	6/15/07	10/15/07		14.90	9.21	19.89	17.12	18.11
2007	Gray	RR-GRA-2.78	6/15/07	10/15/07		15.60	10.23	21.33	18.21	20.16
2007	Gray	RR-GRA-5.08	6/15/07	10/15/07		14.79	10.58	17.63	16.74	17.04
2007	Green Valley	RR-GRE-12.49	6/15/07	10/15/07		15.67	7.32	20.03	17.71	19.24
2007	Dutch Bill	RR-DUT-6.28	6/15/07	10/15/07		15.10	9.09	19.64	17.17	18.41
2007	Dutch Bill	RR-DUT-10.55	6/15/07	10/15/07		13.60	9.62	16.01	15.31	15.76

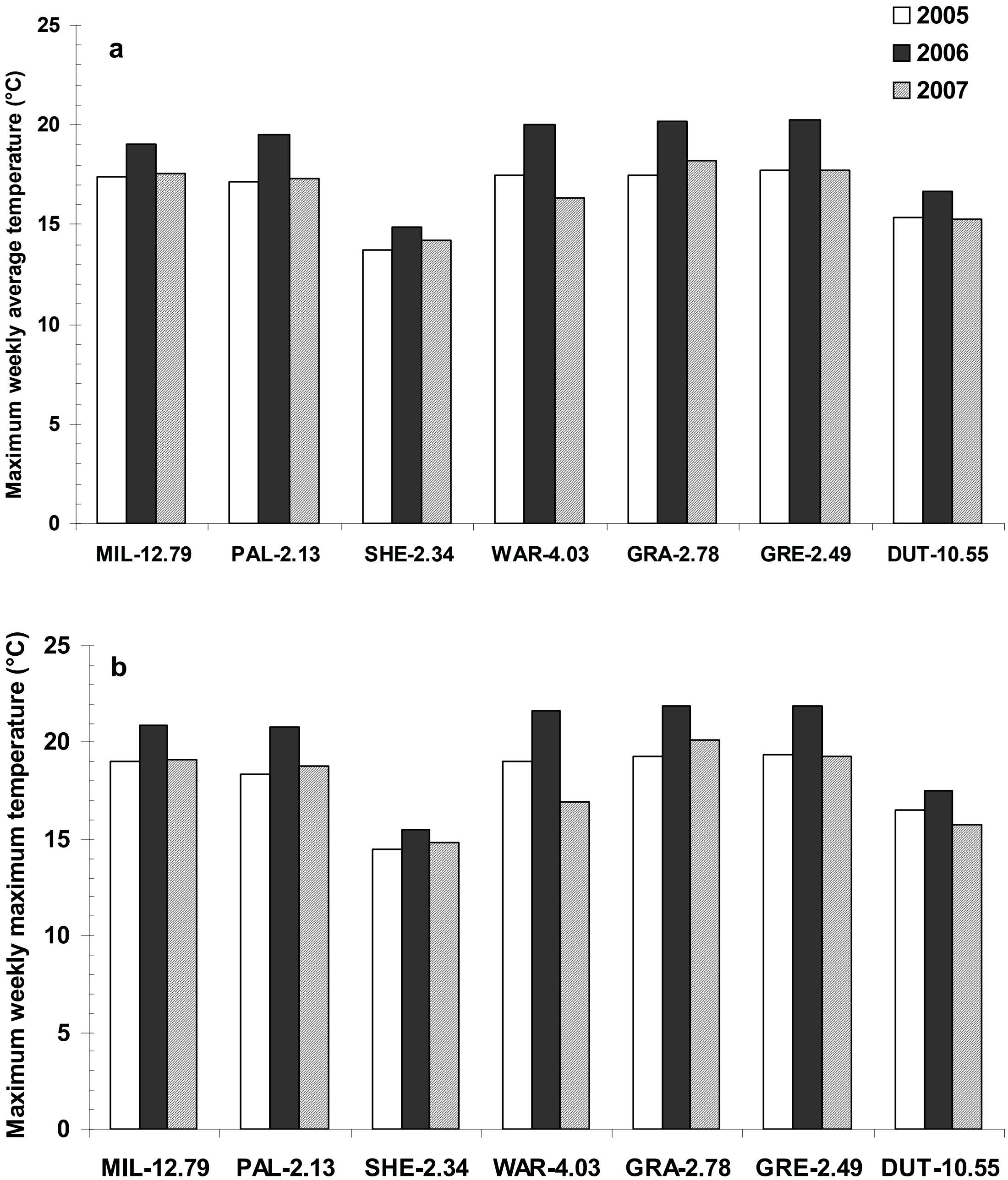

Figure 32. Maximum weekly average temperatures (a) and mean weekly maximum temperatures (b) between 6/15 and 10/15 for stream sites with three consecutive years of data, 2005, 2006, and 2007.

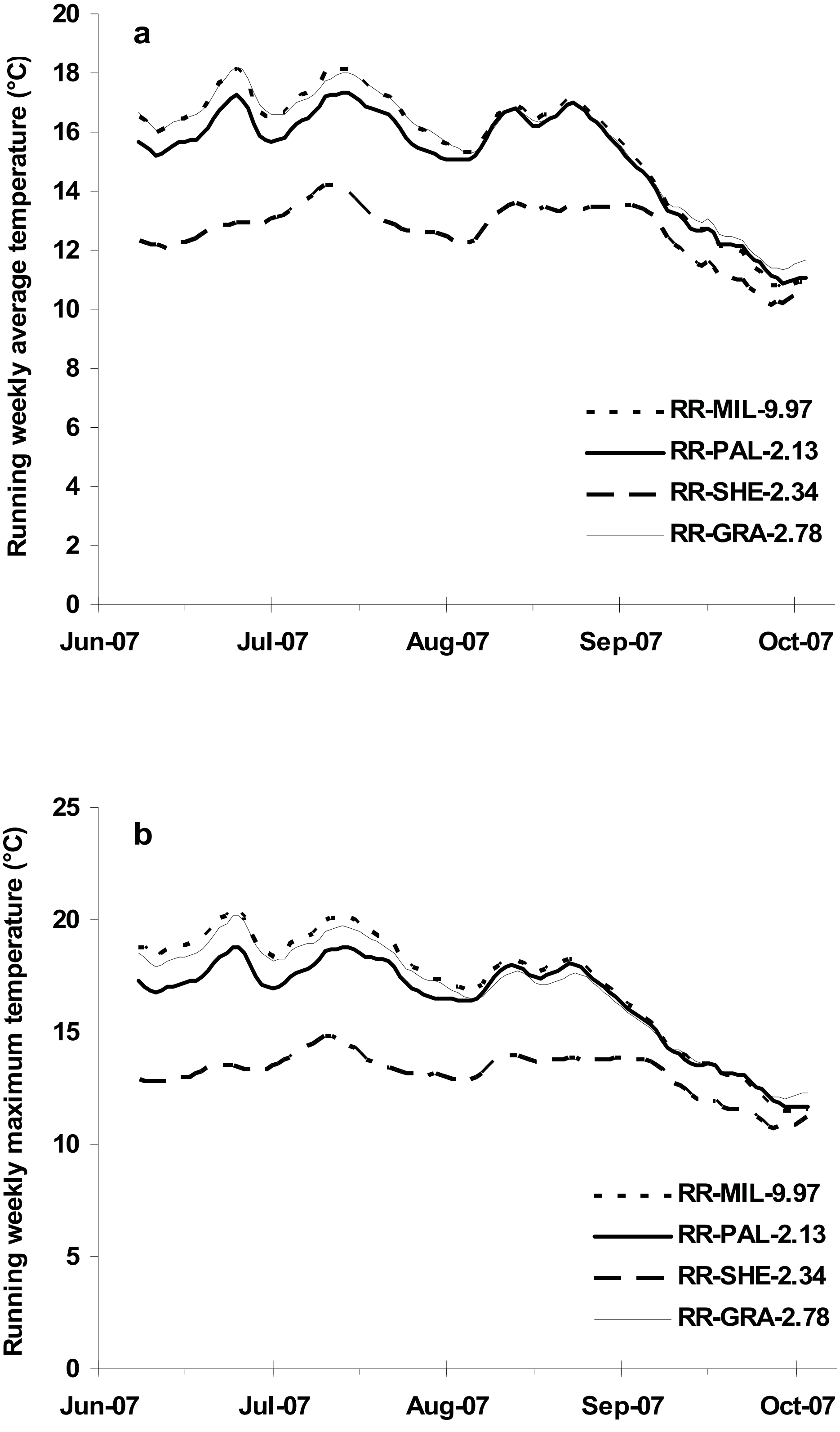

Figure 33. Running weekly average temperature (a) and running weekly maximum temperature (b) for selected monitoring sites on spring stocked program streams between 6/15 and 10/15, 2007.

FLOW COMPARISONS

Stream flow data was collected on several coho program streams in order to document and compare patterns in stream flow among stocking streams, and between stocking streams and comparison streams that sustain wild coho populations.

Methods

Global Water water level loggers were installed at or near the mouths of Mill, Ward, Sheephouse, and Dutch Bill Creeks during the onset of rain in 2007. These meters record stage height on an hourly basis year-round. In addition to the monitoring at these sites, we also used measured mean daily discharge values from the United States Geological Survey gauging station #11467200 in the Austin Creek watershed.

Discharge at various stage heights was estimated by multiplying the average stream velocity (measured with a Global Water flow probe) by the area of a cross section of the stream channel (calculated by multiplying stream width by average stream depth) (Mosley and McKerchar 1993). Regression analysis was used to develop a relationship between stage height and discharge to estimate hourly discharge from stage height recordings.

Results

The 2007-2008 water year was shorter than any of the previous years with the first rains occurring at the end of November and the last storm event occurring in late February (**Figure 34**). Peak storms were also lower than in the previous two water years. Despite the short duration of rainfall, total annual discharge appeared higher in the 2007-2008 water year than in 2006-2007 (**Table 25**). However, comparisons are difficult given the inconsistency in number of sampling days.

Mean daily discharge was greater for an extended time into the summer months during the first two water years compared to the last two water years. In 2008, the reduced spring flows caused mouth closures in Mill, Green Valley and Sheephouse Creeks prior to the end of the smolt migration (see Overwinter survival section). It also resulted in spring/summer fish stranding in lower reaches of program streams (see Oversummer survival section).

There is some variability by watershed, but in general the lowest minimum daily mean discharge rates occurred in 2006-2007 and 2007-2008 and the greatest maximum mean daily discharge rates occurred in either 2004-2005 or 2005-2006. These differences in higher prolonged winter flows and lower summer flows provide a context for when downstream migrant traps were in operation as well as the habitat area documented during the late summer BVET surveys.

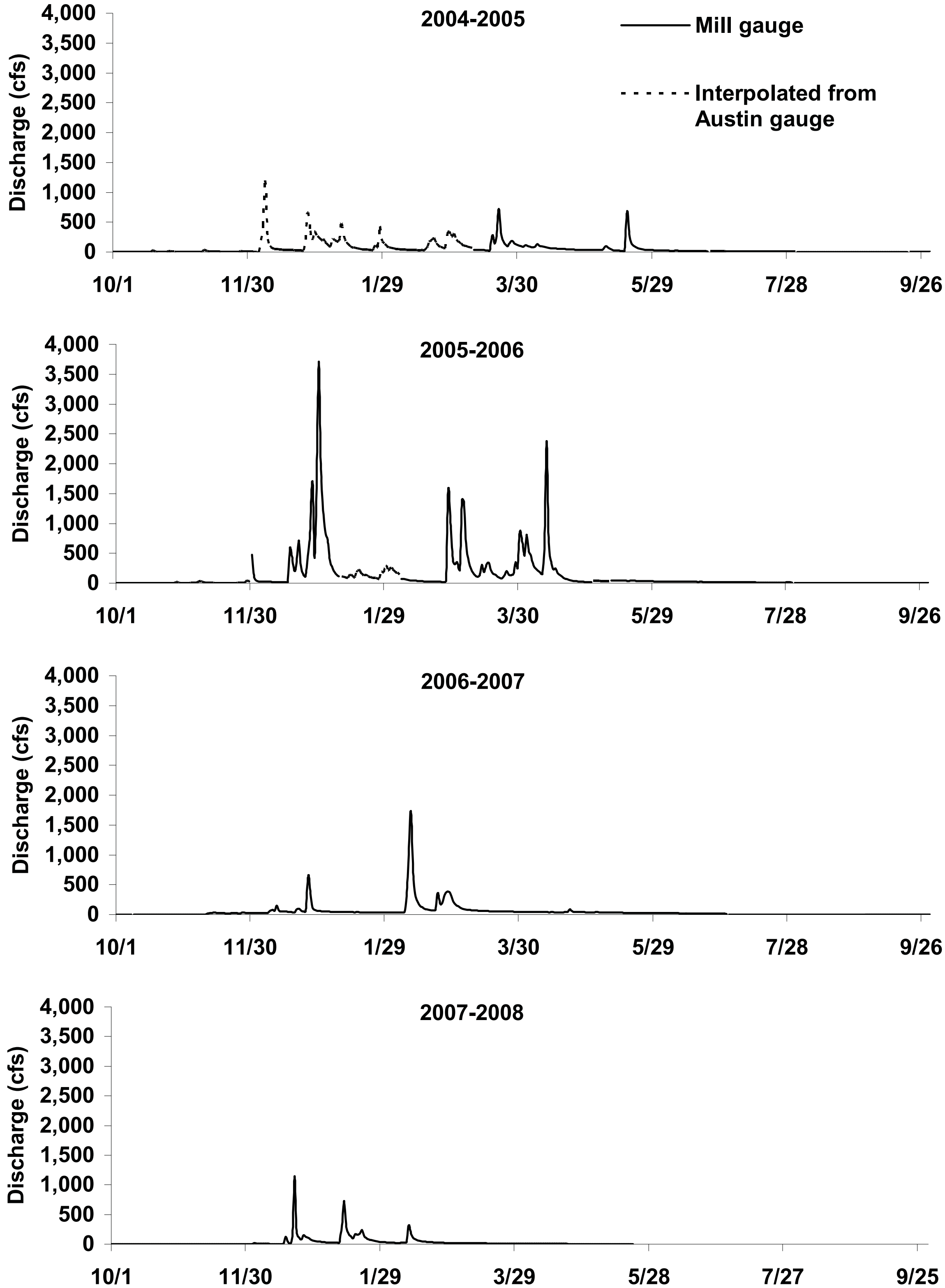

Figure 34. Mean daily discharge at Mill Creek, river km 1.64. Solid lines represent data collected at Mill and dashed lines are values estimated from a regression between Mill and Austin (USGS gauging station #11467200).

Table 25. Summary of discharge data collected annually between October 1 and September 31at various sites on Russian River tributaries in the 2005-2008 water years.

Year	Tribuatary	Sampling Days	Discharge: Min Daily Mean Discharge (cfs)	Discharge: Max Daily Mean Discharge (cfs)	Discharge: Annual Mean Discharge (cfs)	Discharge: Total Annual Discharge (acre-feet)
2004-2005	Mill	155	1.0	719.3	51.2	11,545
2004-2005	Sheephouse	221	1.3	206.1	6.7	4,567
2004-2005	Ward	205	2.2	707.3	35.7	19,724
2004-2005	Green Valley	31	N/A	N/A	N/A	N/A
2004-2005	Dutch Bill	186	1.6	427.3	18.4	10,020
2005-2006	Mill	235	0.8	1,082.3	82.3	38,202
2005-2006	Sheephouse	317	0.2	395.3	37.5	23,619
2005-2006	Ward	313	0.1	1,602.0	93.3	21,888
2005-2006	Green Valley	297	0.6	838.0	18.6	10,895
2005-2006	Dutch Bill	192	0.1	1,063.3	88.0	16,195
2006-2007	Mill	226	0.0	1,735.8	31.8	16,776
2006-2007	Sheephouse	230	0.0	161.3	6.1	3,937
2006-2007	Ward	337	1.6	302.0	14.1	9,184
2006-2007	Green Valley	270	0.0	473.8	37.8	17,000
2006-2007	Dutch Bill	236	0.0	745.2	78.8	8,606
2007-2008	Mill	264	0.0	1,142.3	30.8	32,298
2007-2008	Sheephouse	297	0.0	33.6	20.0	12,256
2007-2008	Ward	261	2.0	954.7	33.3	29,146
2007-2008	Green Valley	177	N/A	N/A	N/A	N/A
2007-2008	Dutch Bill	333	0.0	1,112.6	36.7	22,918

BENTHIC MACROINVERTEBRATE SAMPLING

During the spring and summer of 2007, we collected benthic macroinvertebrate samples from Mill, Palmer, Sheephouse, Ward, Gray, Green Valley, and Dutch Bill Creeks. Our objective was to compare benthic macroinvertebrate biomass and abundance among program streams as a measure of food availability for stocked coho.

Methods

Benthic macroinvertebrate samples were collected from multiple reaches in Mill, Palmer, Sheephouse, Ward, Gray, Green Valley, and Dutch Bill Creeks during the spring/summer of 2007. Samples were collected on all streams in May in lower, middle and upper reaches. On Mill, Palmer, Sheephouse and Gray (spring release streams), additional samples were collected in the middle reaches in June and July. On each sampling occasion, three benthic samples (at three randomly selected transects within a 100m stream section) were collected in each reach for a total of 27 samples per stream over a three month period. Benthic samples were collected in each reach using a Hess sampler (500 µm mesh). At each randomly selected transect, three samples were collected (at right bank, at left bank, and at mid-channel) and then combined to form one composite sample. At each of the three sampling locations within a transect, the Hess sampler was worked into the substrate, and for two minutes the substrate was disturbed to release invertebrates into the net. All samples were stored in 70% ethanol for later analysis. After sample collection, debris was separated from the invertebrates with the aid of a dissecting microscope. Cleaned and sorted samples were then shipped to EcoAnalysts for dry weight determination.

Results

Patterns in average dry weight and number of invertebrates among streams were similar in 2007 to those in 2006 (**Figure 35-Figure 36**). Average dry weight of benthic macroinvertebrate samples was significantly higher in Green Valley Creek than in any of the other streams and contained a significantly higher number of invertebrates. Mill, Palmer, Gray and Dutch Bill Creek samples had intermediate levels, while Sheephouse and Ward were lower. In Mill, Sheephouse and Ward Creeks, benthic macroinvertebrate dry weight data was collected from 2005-2007 (**Figure 35**). No conclusions can be drawn regarding the overall increased mean weights from among years because sample collection methods differed slightly each year (different sampling length in 2005 and only one month sampled in 2007). However, within each year we found the same pattern among streams; Mill samples were highest, Sheephouse samples were lowest, and Ward samples were intermediate (**Figure 35**).

No clear patterns in invertebrate dry weight or quantity were observed among reaches or months in 2007 (**Figure 37-43**). During May, the middle reach of Mill had higher average dry weights and numbers of individuals than the lower and upper reaches. The lower reach of Green Valley had the highest average number of individuals of all samples. In most streams, invertebrate dry weight and quantity were higher in June than they were in May or July 2007. The one exception was that the quantity of individuals found in Mill in June 2007 was lower; it appears that a small number of heavy individuals were found in Mill in June. In general, the patterns observed in dry weight among streams and among reaches within stream were similar to those observed in the quantity of invertebrates, but in some cases varied by reach (Green Valley) or month (Mill) within stream (**Figure 37-40**). This type of variation likely suggests a change in the type of invertebrates present over the course of the season or in different reaches (e.g. fewer but heavier invertebrates present in one month compared to another).

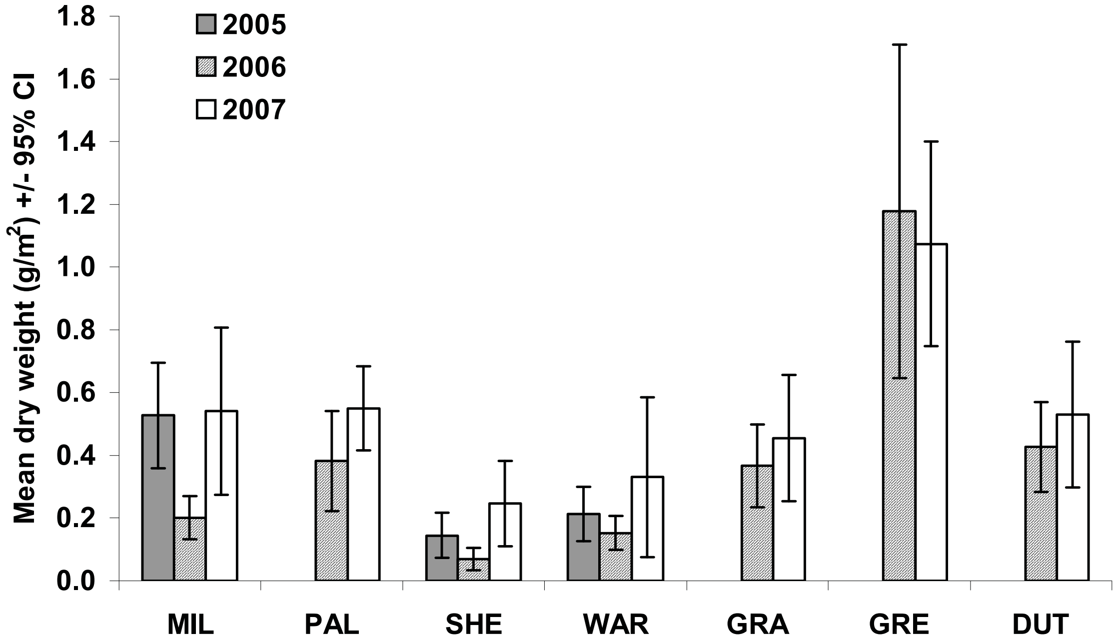

Figure 35. Average dry weight of benthic macroinvertebrate samples collected in multiple reaches of Russian River tributaries monthly from May through July 2005-2007. 2007 data was only collected in May.

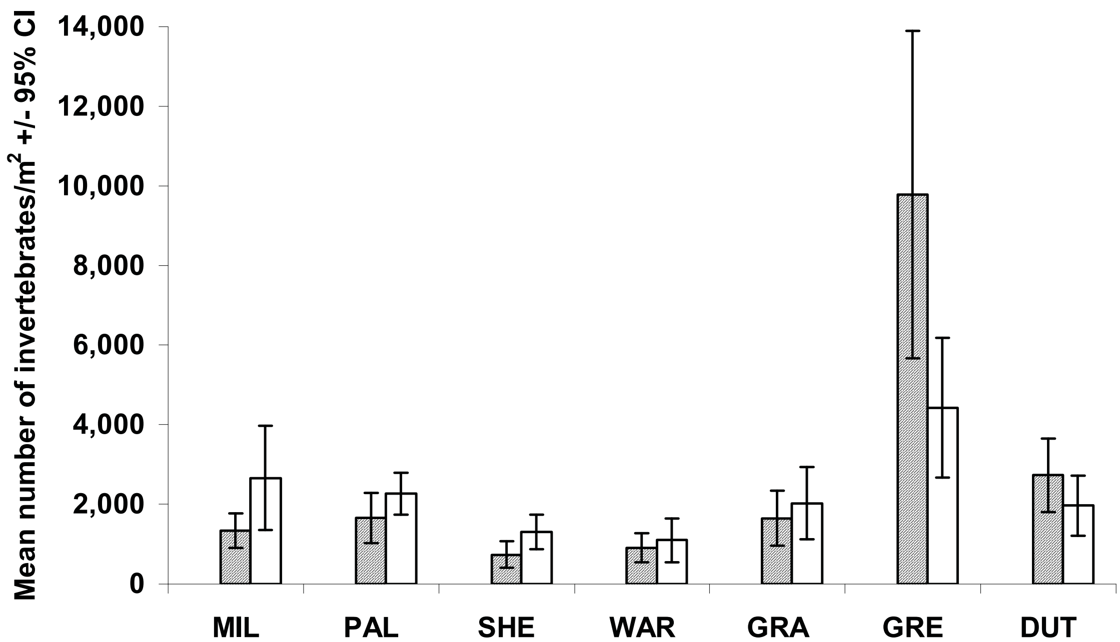

Figure 36. Average number of benthic macroinvertebrate samples collected in multiple reaches of Russian River tributaries monthly in May-July, 2006, and May 2007.

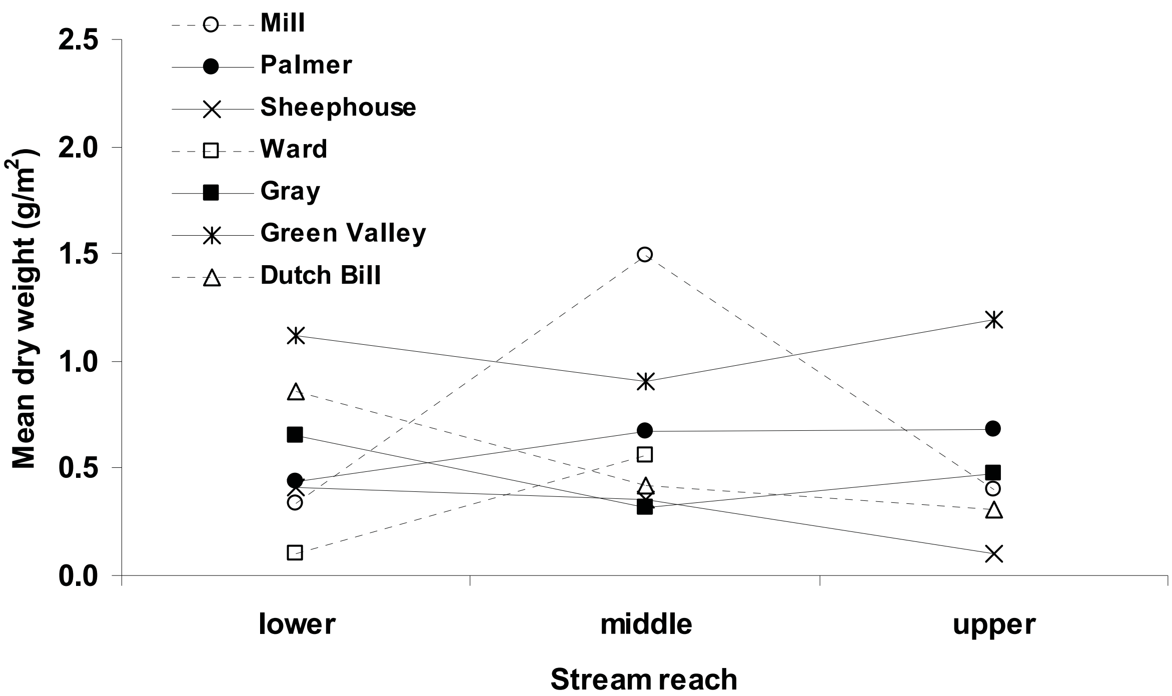

Figure 37. Average dry weight of benthic macroinvertebrate samples taken in lower, middle and upper reaches of Russian River tributaries in May 2007.

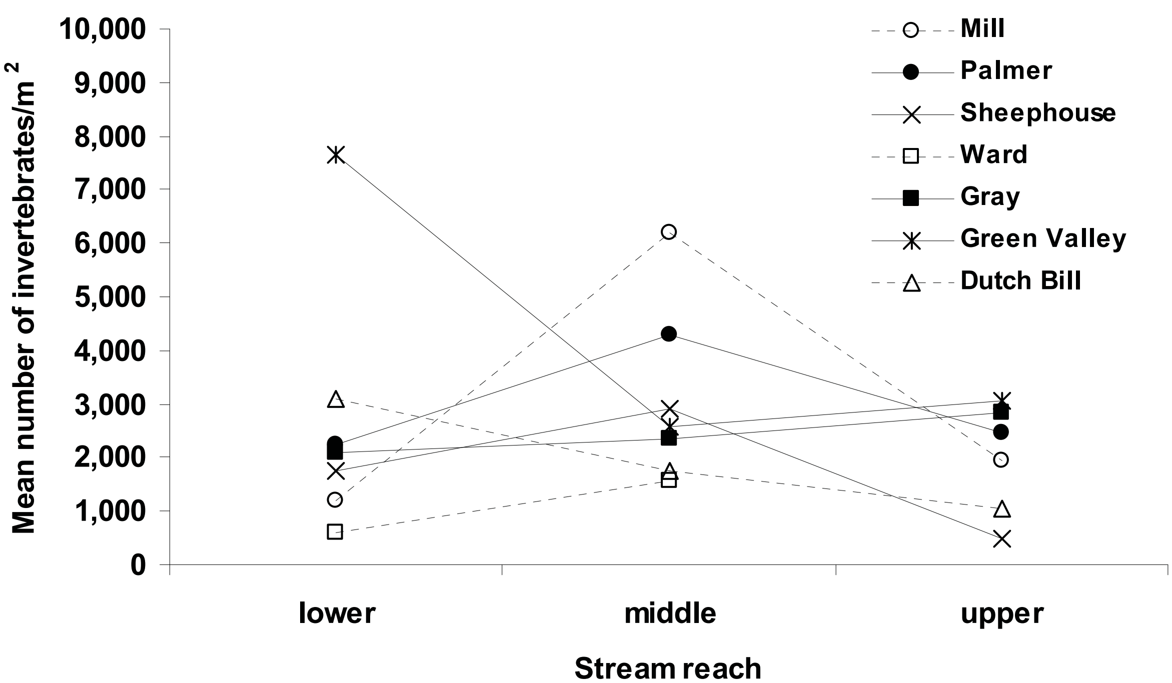

Figure 38. Average number of invertebrates in benthic macroinvertebrate samples taken in lower, middle and upper reaches of Russian River tributaries in May 2007.

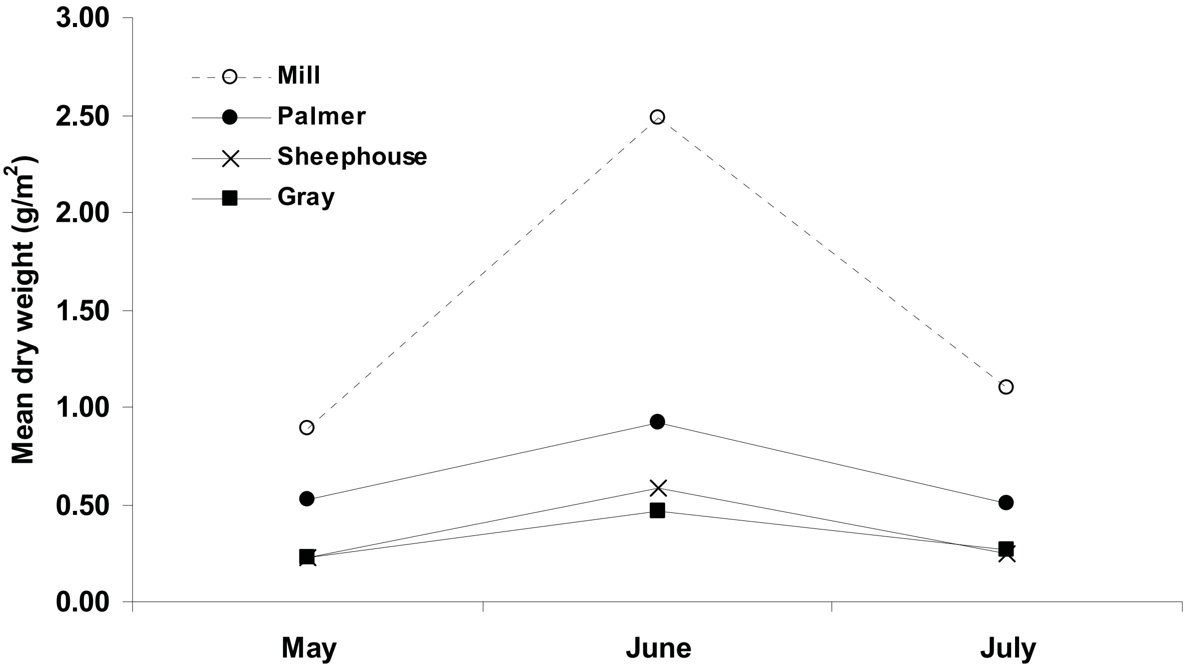

Figure 39. Average dry weight of benthic macroinvertebrate samples taken in the middle reaches of Russian River tributaries in May, June and July, 2007.

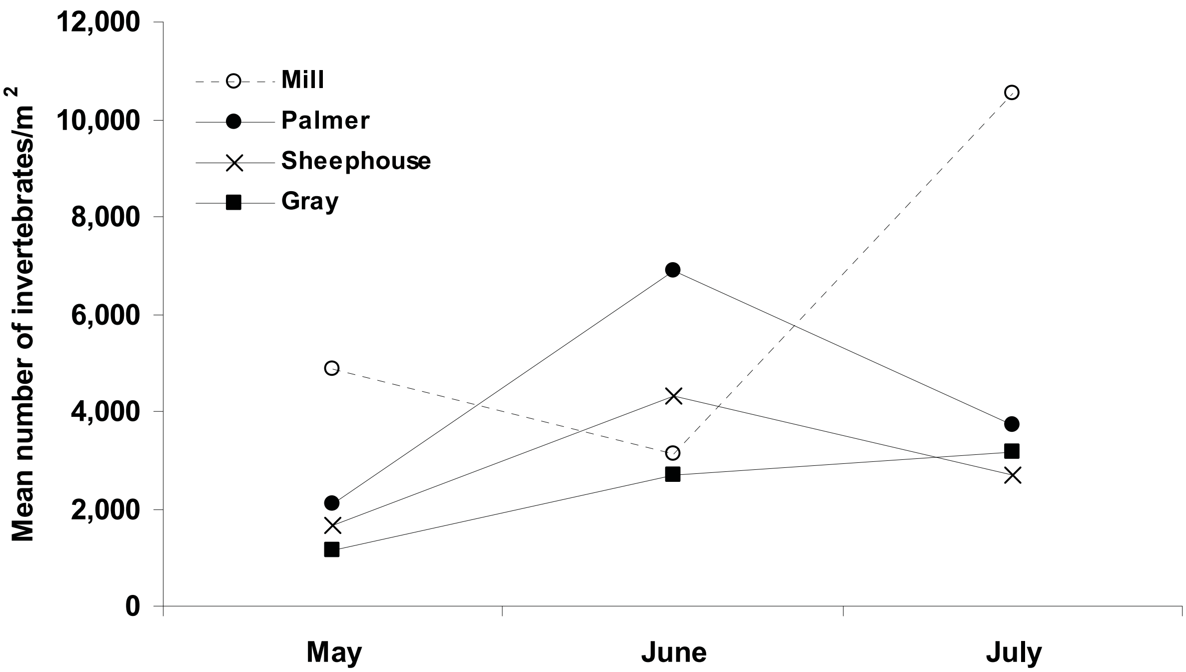

Figure 40. Average number of invertebrates in benthic macroinvertebrate samples taken in the middle reaches of Russian River tributaries in May, June and July, 2007.

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