Russian River Coho Salmon Captive Broodstock Program
Monitoring Activities
Annual Report

July 2006 to June 2007

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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, NOAA Fisheries, 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.

Monitoring Component of RRCSCBP

The University of California Cooperative Extension (UCCE) and California Sea Grant Program are working 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 will be 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 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. With this information, agencies will have the ability 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.

2006-2007 Statement of Goals and Objectives

Our primary goal for 2006-2007 was to compare instream seasonal survival and growth rates among groups of juvenile coho stocked into Mill, Palmer, Sheephouse, Ward, and Gray Creeks during different seasons (spring and 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 2006.
2) Estimate the number, migration timing, size, and condition factor of coho smolts emigrating from stocked tributaries.
3) Estimate instream overwinter apparent survival of coho that were released during the spring and fall of 2006.
4) Compare instream overwinter apparent survival, size and condition factor between spring and fall-released coho.
5) Conduct snorkeling surveys in Green Valley, Dutch Bill, and other Russian River tributaries to determine presence/absence of juvenile coho.
6) Compare macroinvertebrate abundance among program streams as a measure of food availability for stocked coho.
7) 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 NOAA Fisheries 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 2006 (Mill, Palmer, Sheephouse, Ward, Gray, Green Valley, and Dutch Bill Creeks (**Figure 1**), and in Felta and Wallace Creeks which were not stocked but lie within the Mill Creek system. Data collected from July 1, 2006 through June 30, 2007 are summarized in this report and cover the instream portion of the life cycle from summer after (spring) stocking through smolt migration. With respect to stream flow and temperature data, the period covered in this report extends to September 31, 2007.

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 2006-2007 reporting year. Previous annual reports (Conrad et al. 2006, Obedzinski et. al. 2007) present details of the monitoring activities that generated the earlier results compiled in this report. Successive reports will continue with this compilation so that each report provides a summary of the results from the monitoring program over time.

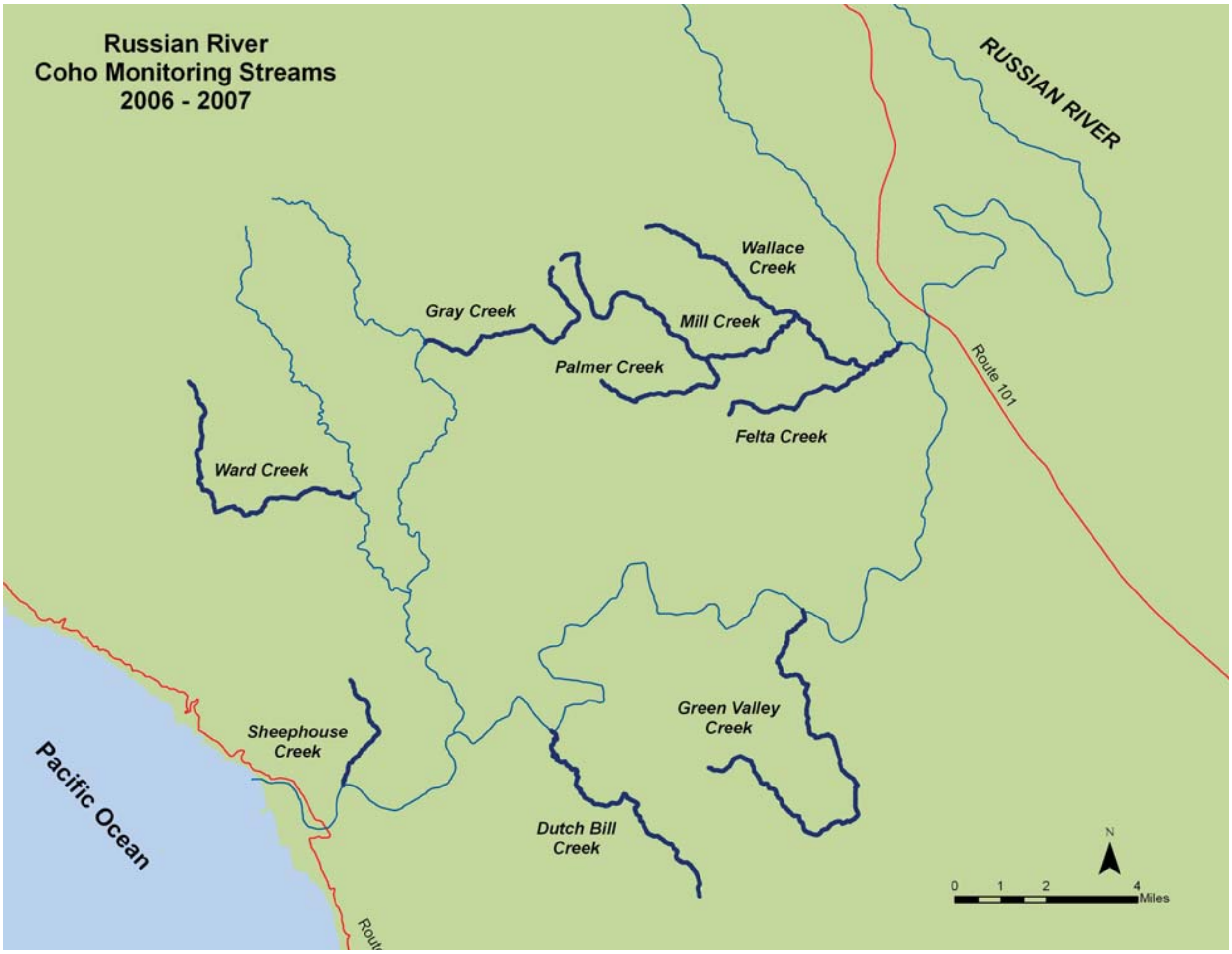


Figure 1. Map of Russian River coho program streams monitored in 2006-2007.

DATA COLLECTION AND ANALYSIS

OVERSUMMER SURVIVAL ESTIMATES

Summer field data was collected to estimate late summer abundance and oversummer apparent survival of coho released from Warm Springs Hatchery into five creeks during the spring of 2006. In addition, we collected data on fish size and condition in the five release streams.

Methods

Population estimates using the basinwide visual estimation technique (BVET) (Dolloff et. al. 1993) were conducted on Mill, Palmer, Sheephouse, Gray, and Ward Creeks to estimate population size at the end of summer (August – September) 2006. 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 upstream to a known migration barrier for juvenile coho. Surveyors walked each reach from downstream to upstream classifying habitat units as pools, glides, or riffles. 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, while approximately every fifth pool and glide was snorkeled in longer streams (Mill and Ward). 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 ($\geq$ 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 each habitat type were calculated using the calibrated dive counts (pools and glides) or electrofishing estimates (riffles). 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. Because we had no means of detecting fish that migrate out of the stream between the time of stocking and our BVET survey, we could only estimate "apparent" survival, or the number of stocked fish remaining in the stream at the end of the summer. We did not know the quantity or the fate (emigration or death) of fish that were not captured in the stream at the end of the summer so we could not incorporate such information into our estimates. Because the interval between spring stocking and completion of the BVET surveys differed among 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, 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 per pool were anesthetized in a bucket of water containing Alka Seltzer and measured for 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. All other fish and non-fish species were quantified.

Results

BVET surveys

BVET surveys were completed on Mill Creek (8/8-9/12), Palmer Creek (9/11-9/26), Sheephouse Creek (9/12-9/25), Ward Creek (8/7-8/30), and Gray Creek (8/20-10/5). Survey reaches on each creek extended from our downstream migrant trap site or the mouth of the stream to an upstream migration barrier above the uppermost stocking site (**Figure 2 through 6**). 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.

Survey reaches ranged from 2.6 to 12.7 km (**Table 1**). The two additional streams surveyed in 2006 (Mill and Ward) were significantly longer than the three other streams. In streams that were surveyed in 2005 and 2006, overall wetted area was less in 2006 (**Table 1**). Pool to riffle ratios were higher in 2006, likely a result of reduced riffle habitat due to lower flows (**Table 1**). In smaller streams (Palmer, Sheephouse and Gray), 51-52% of pool units and 36-49% of glide units were snorkeled, and in larger streams (Mill and Ward), 20-24% of pool units and 19-24% of glide units were snorkeled (**Table 2**). Additionally, in smaller streams 15-18% of pool units, 11-25% of glide units, and 6-14% of riffle units were electrofished (**Table 2**). In larger streams 6-12% of pool units, 9-10% of glide units, and 4-8% of riffle units were electrofished (**Table 2**). Riffles were too shallow to effectively snorkel so we relied entirely on electrofishing estimates to determine average coho densities in riffle habitat.

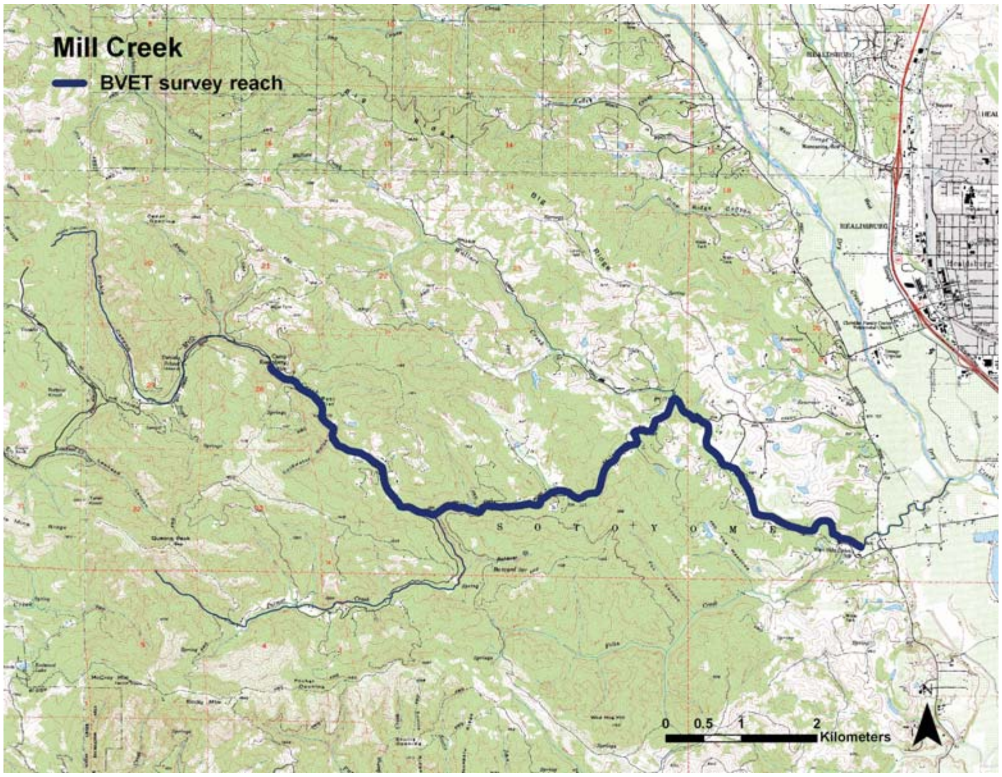
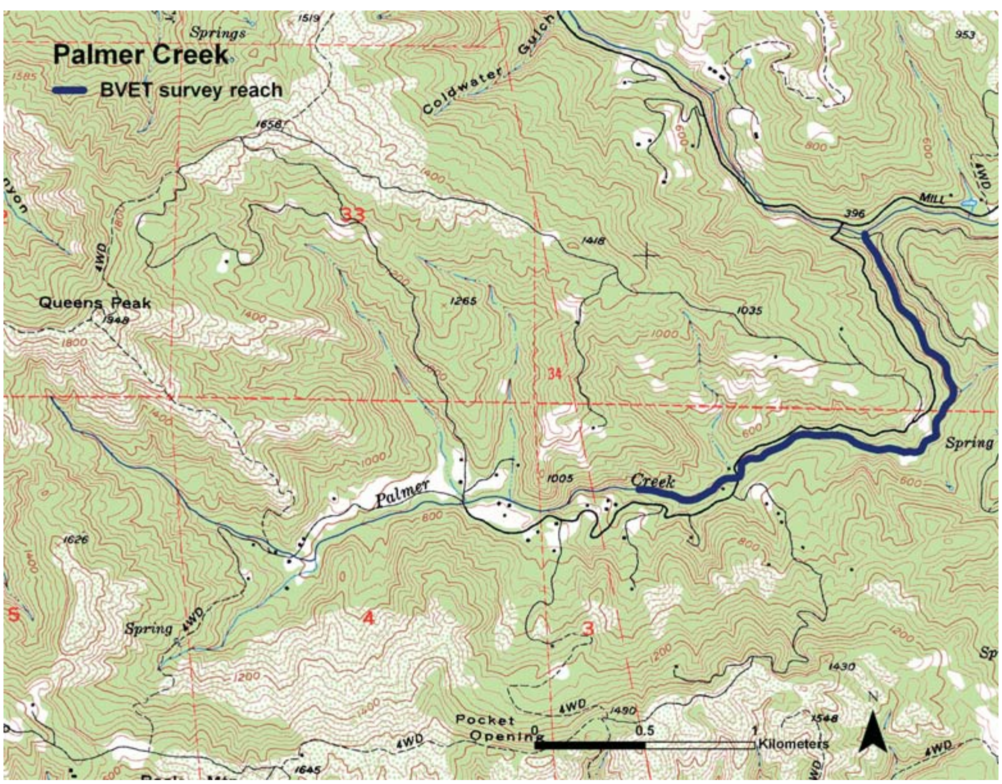


Figure 2. Map of BVET survey reach on Mill Creek, 2006.



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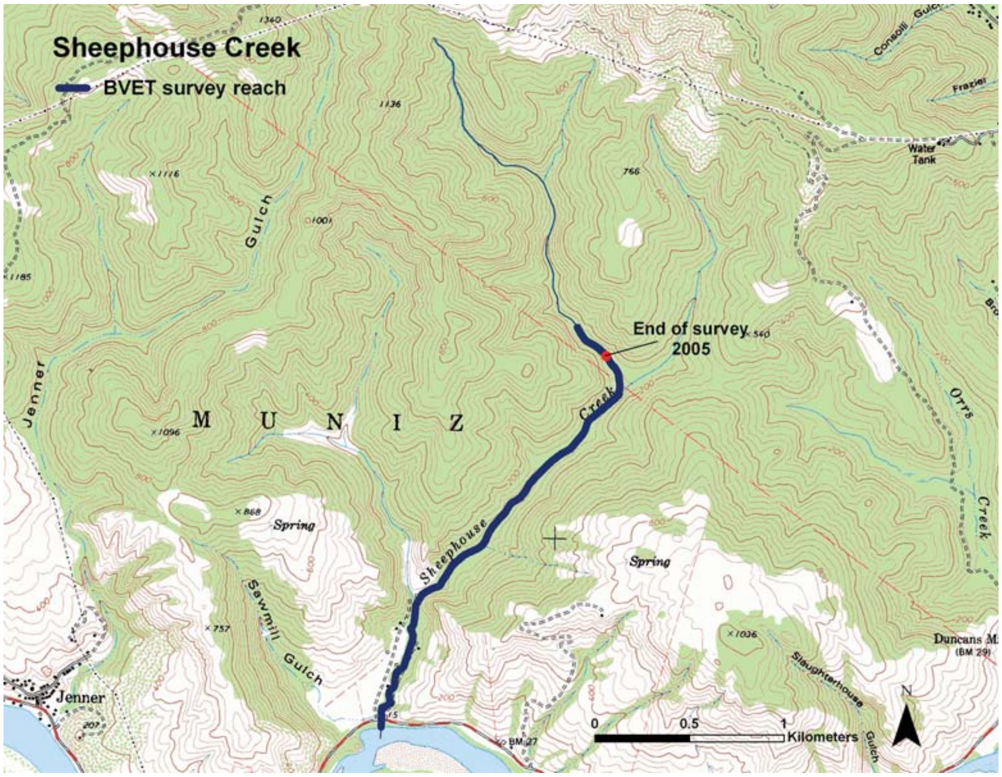

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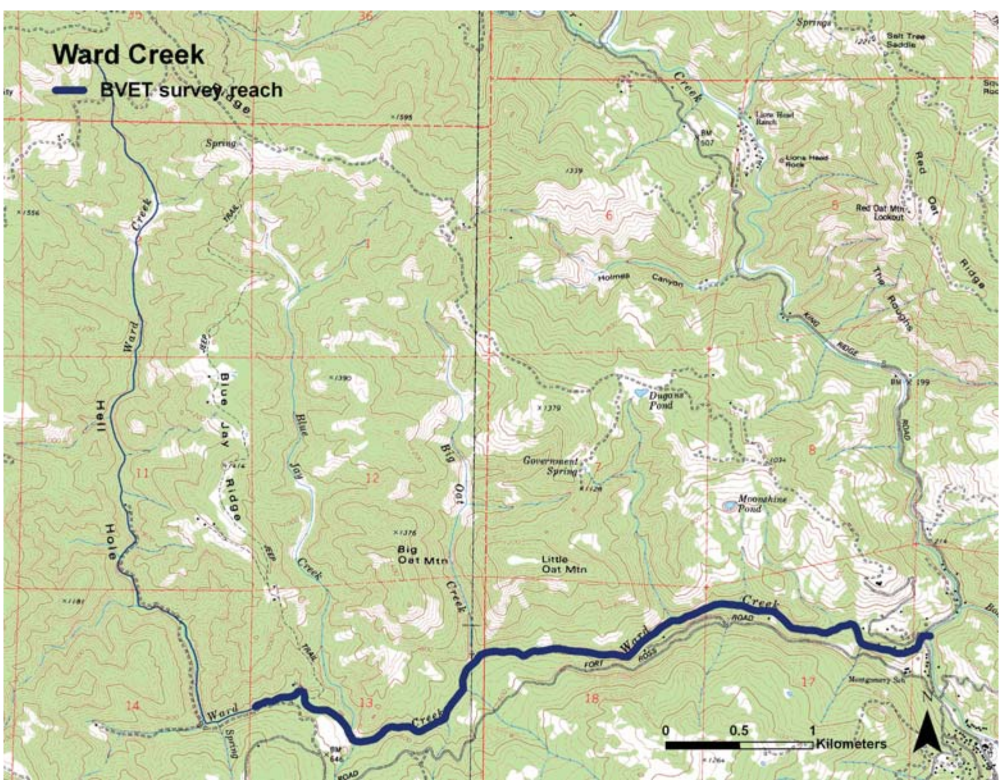


Figure 5. Map of BVET survey reach on Ward Creek, 2006.

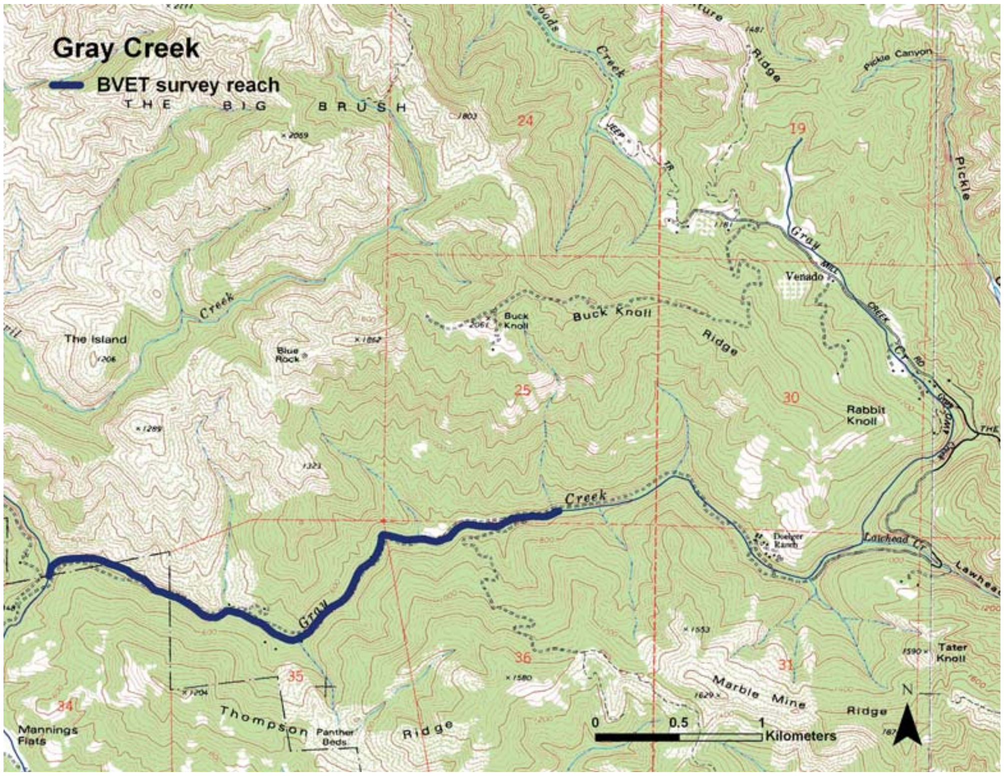


Figure 6. Map of BVET survey reach on Gray Creek, 2005 and 2006.

Table 1. Habitat characteristics of stream reaches sampled for BVET estimates, 2005 and 2006.

Year	Tributary	Survey dates	Reach length (km)	Wetted area (m^2)				Percent of total		
				Pools	Glides	Riffles	Total	Pools	Glides	Riffles
2005	Palmer	8/8 - 8/10	2.8	3,963 +/- 0	1,339 +/- 0	4,057 +/- 50	9,359 +/- 87	42	14	43
2005	Sheephouse	9/1 - 9/7	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	5,895 +/-0	2,062 +/-0	4,628 +/- 0	12,585 +/-0	47	16	37
2006	Mill	8/8 - 8/21	12.7	36,134 +/- 1,235	10,299 +/- 600	14,794 +/- 488	61227 +/- 2,502	59	17	24
2006	Palmer	9/11 - 9/14	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	3,366 +/- 26	2,557 +/- 0	731 +/- 0	6,654 +/- 45	51	38	11
2006	Ward	8/7 - 8/16	6.3	13,648 +/- 784	7,738 +/- 589	6,057 +/- 463	27,443 +/- 1,853	50	28	22
2006	Gray	8/20 - 8/28	4.2	7,133 +/- 13	1,541 +/- 0	2,032 +/- 212	10.705 +/- 367	67	14	19

Table 2. Percentage and number of pools, glides and riffles sampled using snorkeling (SN) or electrofishing (EF) methods for 2005 and 2006 BVET surveys. Riffles were not snorkeled due to shallow depths.

Year	Tributary	Pools			Glides			Riffles		
		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	174	51 (89)	15 (26)	94	49 (46)	16 (15)	147	0	6 (9)

Calibration ratios (electrofishing estimate/dive count) used to adjust the dive counts varied by stream, habitat type, and year, ranging from 0.84 to 1.49 in pools and 1.25 to 3.31 in glides (**Table 3**). The high calibration ratio in Palmer 2006 (3.31) is likely explained by the difficulty of counting fish in the extremely shallow glides observed that year in Palmer. In Mill and Gray pools, calibration ratios were less than one (**Table 3**), indicating that fish were either double counted (which often occur in larger pools) or that the assumption of no mortality or emigration between snorkeling and electrofishing samples was violated.

Table 3. Calibration ratios (electrofishing estimates/snorkeling counts) of pool (P) and glide (G) units sampled during BVET surveys, 2005 and 2006.

Year	Tributary	# Calibration units		Calibration ratio (R^2)	
		P	G	P	G
2005	Palmer	13	13	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 (0.72)	1.25 (0.82)
2006	Palmer	14	10	1.46 (0.84)	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)

Coho abundance and oversummer apparent survival

Late summer abundance of spring-released coho in 2006 was highest in Sheephouse Creek and similar among the other four streams despite significantly higher stocking rates in Mill and Ward Creeks (**Table 4**, **Figure 7**). Oversummer apparent survival rates on Palmer, Sheephouse, and Gray in 2006 (ranging from 0.37 to 0.69) were similar but more variable than estimates in 2005 (ranging from 0.47 to 0.66) (**Table 4**, **Figure 8**), and only slightly lower than estimates in

Table 4. Estimated abundance and oversummer apparent survival of spring released juvenile coho stocked into Russian River tributaries, 2005 and 2006.

Year	Tributary	Number stocked	Stock date range	Electrofishing sample date range	Abundance (95%CI)	Apparent survival (95% CI)[1]
2005	Palmer	2,466	6/09 - 6/09	8/16 - 8/18	1,603 (1,315 -1,890)	0.47 (0.33 - 0.63)
2005	Sheephouse	7,024	5/31 - 5/31	9/08 - 9/15	4,193 (3,537- 4,850)	0.54 (0.45 - 0.65)
2005	Gray	2,584	6/21 - 6/21	9/28 - 10/03	1,839 (1,415 - 2,263)	0.66 (0.48 - 0.85)
2006	Mill	5,297	6/13 - 6/14	8/31 - 9/12	997 (562 - 1,432)	0.09 (0.04 - 0.15)
2006	Palmer	2,102	6/12 - 6/12	9/15 - 9/26	1,172 (799 - 1,544)	0.49 (0.31 - 0.69)
2006	Sheephouse	2,911	6/21 - 6/21	9/18 - 9/25	2,199 (1,648 - 2,749)	0.69 (0.47 - 0.93)
2006	Ward	5,690	6/19 - 6/20	8/22 - 8/30	1,395 (863 - 1,926)	0.08 (0.03 - 0.14)
2006	Gray	3,201	6/15 - 6/15	9/28 - 10/05	1,310 (1,076 - 1,544)	0.37 (0.29 - 0.44)

[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).

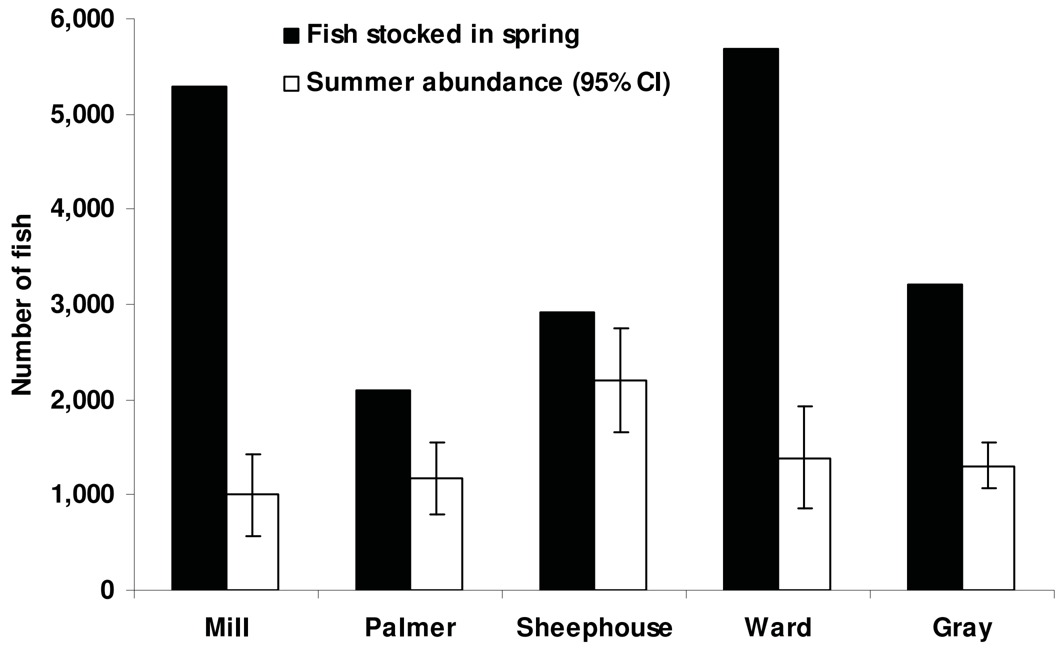


Figure 7. Number of spring released coho and late summer abundance estimates for Russian River tributaries stocked in 2006.

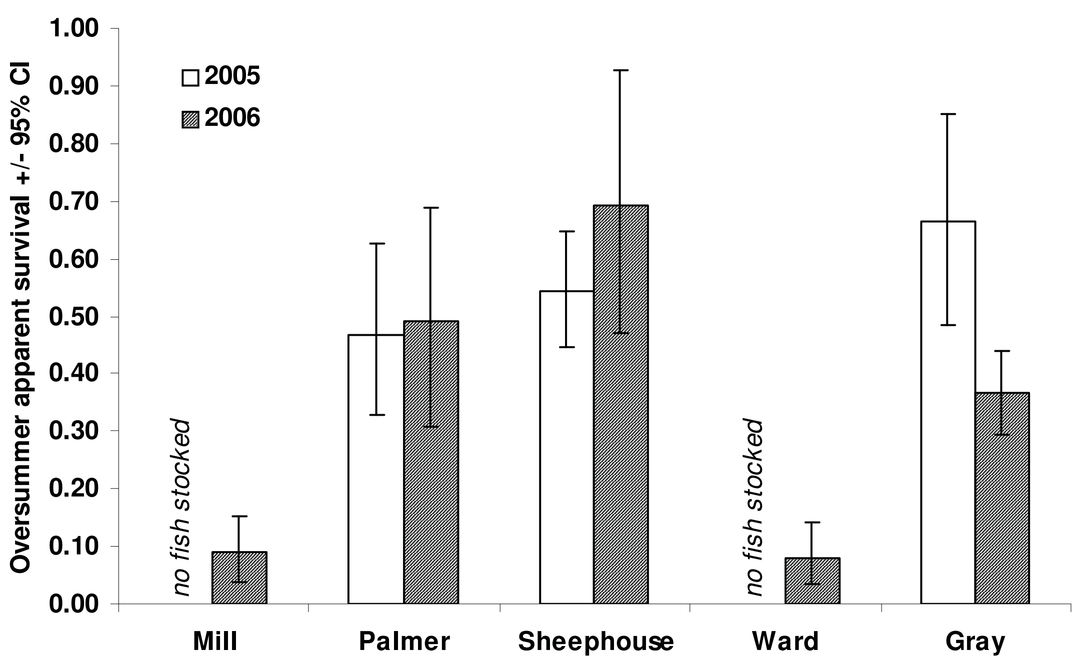


Figure 8. Oversummer apparent survival (June 15 - October 15) of spring released juvenile coho stocked into Russian River tributaries, 2005 and 2006.

pristine streams with wild coho populations in Northern California (Brakensiek 2002) and Oregon (Kruzic et. al. 2001). Apparent oversummer survival rates on Mill and Ward Creeks, however, were extremely low (0.09 and 0.08, respectively) (**Table 4**, **Figure 8**).

Because we calculated estimates of apparent survival (and not true survival), these estimates can be considered minimum estimates of true survival. It is not likely that all of the fish absent from the stocking streams at the end of the summer perished, but rather a portion of them likely left the stream and survived elsewhere. Observations of program fish in other streams from snorkeling surveys and downstream migrant trap capture provide evidence that some level of movement occurred.

In some streams, movement is more likely to occur than in other streams depending on annual flow and connectivity to other streams, and this, in turn, may have affedcted our estimates of apparent survival. For example, on Sheephouse Creek in 2006, the mouth of the stream was closed at the time of stocking. Because of this, fish were unable to leave the stream prior to our BVET survey, and effectively we were able to estimate true survival. During the 2005 release, Sheephouse was connected to the Russian River, and we observed coho yoy in our downstream migrant trap in June, presumably migrating out of the stream and reducing our estimate of apparent survival. The higher apparent survival rate observed in 2006 compared with 2005 was likely influenced by the fact that the mouth was closed in 2006. In all other streams in both years, water flowed out of the mouth at the time of stocking, allowing fish an opportunity to migrate from the streams prior to our BVET samples. If fish migrated out of each stream at variable rates, apparent survival rates would in turn be reduced at variable rates. However, we had no means of quantifying this. Subsequent monitoring of movement through the use of passive integrative transponder (PIT) tag technology is contributing to our understanding of coho movement and survival. However, these efforts are outside the scope of this report and will be reported on in future summaries.

Stocking density may have influenced inter-annual variation in oversummer apparent survival. Sheephouse was stocked at a lower density in 2006 (2,911 v. 7,024 in 2005) and apparent survival estimates were higher at the lower stocking density (**Table 4, Figure 7 and 8**). This pattern also occurred in Gray Creek; apparent survival in 2006 was slightly lower when it was stocked at a slightly higher density (3,201 v. 2,584 in 2005) (**Table 4, Figure 7 and 8**).

There are a number of factors that may explain the lower apparent survival rates on Mill and Ward Creeks. Mill and Ward are higher flow systems, and may have had higher rates of emigration after stocking (Obedzinski et. al. 2007). Ward and Mill Creek on average had warmer water temperatures than in the other three creeks (see temperature section), and above thresholds observed in Northern California streams (Welsh et. al. 2001).

Another possibility is that our sampling design was not as effective on the larger streams. Ward, in particular, has a number of large deep pools that are difficult to snorkel or electrofish, which may have biased our estimates low. Additionally, because of the larger stream size, we snorkeled a lower proportion of pools (every fifth pool on Mill and every fourth on Ward). If fish were highly concentrated in small areas, and by chance we did not sample those areas, this could also bias our estimates low. This would be less likely to occur on the smaller streams where we were able to snorkel half of the pool habitat.

Coho densities

Coho densities were generally higher in pool habitat compared with glide habitat and coho were rarely present in riffle habitat (**Table 5**). In both years, Sheephouse supported the highest densities of coho in all habitat types, however, variation in stocking densities among streams and among years must be considered in making late summer density comparisons.

Table 5. Average summer coho yoy densities in pool, riffle, and glide habitat in Russian River tributaries stocked in spring 2005 and 2006.

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)

Size and growth

Assuming no size dependent emigration or mortality from the release streams, stocked coho increased in average fork length and weight over the summer in all five streams (**Table 6**). In contrast, average condition factor (K) was lower during the BVET samples than in the sample taken immediately prior to release (**Table 6**). Despite similar prestocking sizes in 2005 and 2006, average sizes during the 2006 BVET sample were lower than in 2005.

Length, weight and condition factor data were difficult to compare among streams because the BVET sample dates were, in some cases, almost a month apart (**Figure 9**). By comparing specific growth rate ($g = (\ln W_2 - \ln W_1)/t_2 - t_1$, where W = weight or length and t=median sample date), we accounted for the difference in sampling intervals in order to better compare growth among streams. However, because we did not have individual data, we made the assumption of no size dependent processes and that growth rates were consistent throughout the summer. Furthermore, we could not calculate confidence intervals. If we accept this assumption, we can conclude that overall specific growth rates for length and weight were lower in 2006 than in 2005 (**Table 7**). In 2006 we found higher variation in growth rates among streams with Mill fish having the highest growth rates and Gray fish the lowest (**Table 7**). For each stream, daily specific growth rates were used to predict the size of spring released fish on October 15 (approximate time of fall release) (**Table 7**). This allowed for size comparisons between spring and fall released fish at the time of fall stocking.

Table 6. Average fork length (FL), weight (WT) and condition factor (K) of juvenile coho before release and during late summer BVET surveys, 2005 and 2006.

Year	Trib	Prestocking averages (95% CI)					BVET averages (95% CI)				
		Sample date	n	FL (mm)	WT (g)	K	Avg 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	264	67.3 (+/- 0.8)	3.53 (+/- 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	644	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	78	69.3 (+/- 1.4)	4.03 (+/- 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	260	64.6 (+/- 0.8)	3.15 (+/- 0.12)	1.14 (+/- 0.02)
2006	SHE	6/20	150	61.9 (+/- 1.1)	3.28 (+/- 0.18)	1.35 (+/- 0.02)	9/20	305	69.3 (+/- 0.9)	3.77 (+/- 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	138	68.3 (+/- 1.0)	3.67 (+/- 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	187	67.2 (+/- 0.8)	3.20 (+/- 0.13)	1.03 (+/- 0.02)

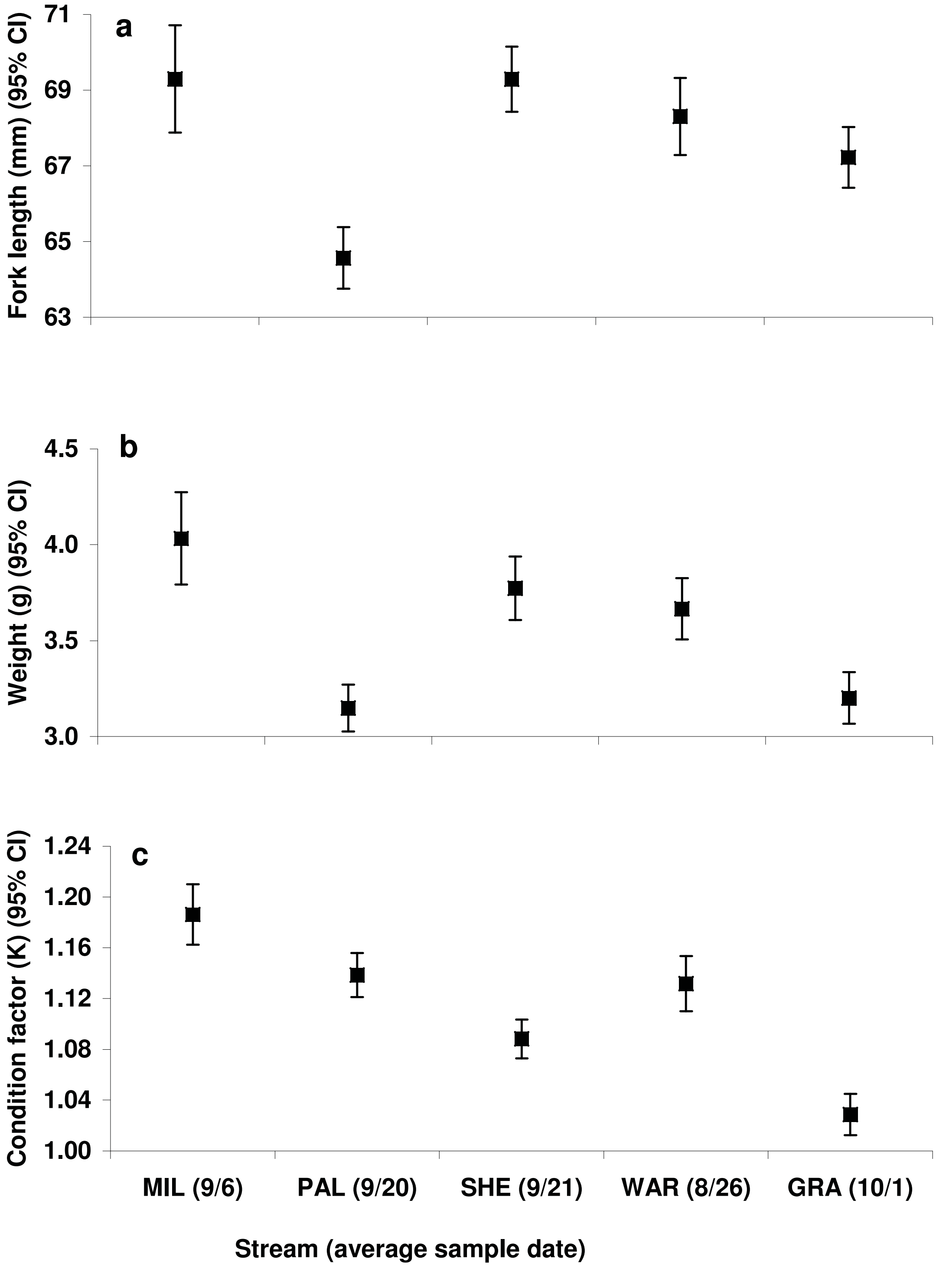


Figure 9. Mean fork length (a), weight (b) and condition factor (c) of coho captured in spring release streams during 2006 summer BVET surveys.

Table 7. Specific growth rates and predicted sizes for fork length (FL) and weight (WT) of juvenile coho stocked into Russian River tributaries, springs 2005 and 2006.

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

[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 8**). The largest number of steelhead was captured in Gray and Ward Creeks. Sculpin spp. were observed in all streams except Gray Creek, lamprey spp. were only found in Mill Creek, and roach were only found in Mill and Gray Creeks. Non-native fish species were only found in Mill and Palmer Creeks.

Table 8. Fish and non-fish species counts of fish captured electrofishing during BVET sampling, 2005 and 2006.

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
2005	Palmer	28	1,389	269	0	233	0	55	0	0	0	0	0	0	5	0	0
2005	Sheephouse	35	1,213	741	1	115	0	315	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
2006	Mill	35	3,239	82	0	765	128	763	248	1	9	0	1	5	19	0	0
2006	Palmer	34	1,399	260	0	367	0	133	0	0	0	0	0	1	25	0	0
2006	Sheephouse	35	1,238	308	0	130	0	162	0	0	1	0	0	0	2	0	0
2006	Ward	36	2,090	140	0	1,127	0	27	0	0	0	3	0	0	79	1	2
2006	Gray	38	1,660	188	0	1,001	0	0	213	0	0	0	0	0	65	8	21

Mortality

Electrofishing injuries or mortalities that occurred during the BVET samples were minimal (**Table 9**), overall increasing slightly from 2005. The increase was likely due to lower flow conditions in 2006.

Table 9. Percentage and number of coho and steelhead electrofishing sample injuries and mortalities during 2005 and 2006 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% (0/1,127)	0% (0/1,127)
2006	Gray	0.5% (1/188)	0.5% (1/188)	0.1% (1/1,001)	0.4% (4/1,001)

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

Snorkeling surveys were conducted during the spring and summer of 2006 in order to document the presence or absence of wild coho salmon yoy in program streams. The purpose of these surveys was to ensure that hatchery fish would not be stocked where wild fish were residing and to provide evidence for the suspected decline of wild coho populations in Green Valley and Dutch Bill Creeks.

Methods

Green Valley and Dutch Bill Creeks were snorkeled extensively in order to determine the presence of any remaining wild coho from the populations that were recently observed within these creeks. A small portion of Felta Creek was also surveyed. Each creek was divided into reaches and the majority of the pools in each reach were snorkeled. Surveys were conducted by two-person teams. Each pool was snorkeled and the number of coho salmon and steelhead present were recorded as well as the presence of different life stages. Each coho observed was checked for an adipose fin clip, which would signify if the individual was of wild (intact adipose fin) or hatchery (clipped adipose fin) origin. Additionally, length, average width, and average depth were recorded in each pool snorkeled.

Results

Felta Creek

Because 25 wild coho yoy (BY 2004) were captured in the Mill Creek downstream migrant trap in 2005, we initiated a series of presence/absence surveys in Felta Creek in order to discern the source of these wild coho. The confluence of Felta and Mill Creeks is immediately upstream of the trap site. During the 2005 snorkel surveys, 29 wild coho yoy were found. On May 12, 2006, a half mile of Felta Creek was snorkeled, from the mouth past two clear upstream juvenile barriers (a concrete summer dam with a plunge of three feet and a high-gradient boulder section). Every pool (approximately 20-30) was snorkeled within this reach and 40 to 50 wild coho yoy were observed. Approximately 20 of these wild coho were found above both juvenile barriers, suggesting a successful spawning event in Felta during the winter of 2005-2006. Results from the 2005 and 2006 surveys confirm two successful year-classes (BY 2004 and BY 2005) of wild coho in this stream.

Mill Creek

Mill Creek was snorkeled during June 2006 to determine the presence or absence of wild coho salmon yoy prior to the spring release of coho yoy. Approximately 60 pools were snorkeled between the downstream migrant trap site to above the confluence with Palmer Creek. No coho salmon juveniles were observed.

Green Valley Creek

Historically, Green Valley Creek had three consecutive year-classes of wild coho salmon, and for fifteen years prior to 2005, wild coho juveniles were observed, trapped, or collected almost every year (Cook and Manning 2002; Fawcett et al. 2003; Conrad et. al. 2005; CDFG 2006).

During the 2005 presence/absence snorkel surveys, no coho yoy (BY2004) were found (Obedzinski et al. 2007), marking the first year in which no coho presence was observed. During July 11-19, 2006, four reaches of Green Valley Creek were snorkeled from the mouth to the second Green Valley Road Bridge **(Figure 10)** and, as in 2005, no wild coho were found. These results suggest that two consecutive year-classes (BY 2004 and BY 2005) of wild coho have disappeared from this creek.

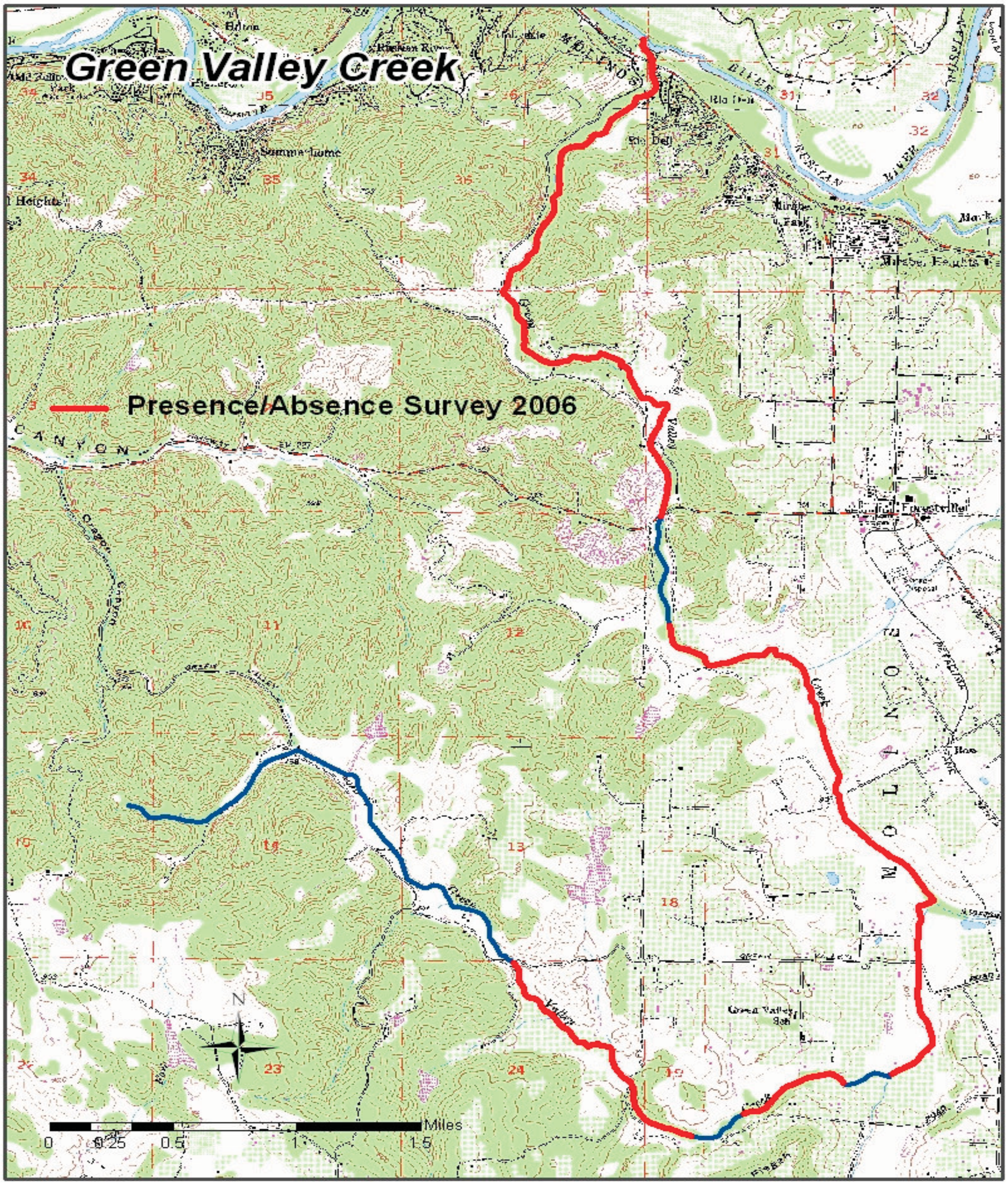


Figure 10. Green Valley Creek Presence/Absence Survey reach map, with Reach 1 beginning at the mouth and Reach 4 ending at the second Green Valley Road Bridge.

Thirty-five pools were snorkeled in the first reach, from the mouth to the Highway 116 Bridge (**Figure 10**). In this reach, we observed a total of 20 juvenile steelhead and the juvenile steelhead density averaged 0.57 +/- 0.36 steelhead/pool **(Figure 10 and 11**). However, several of the pools had poor visibility and appeared anoxic. Other species observed were green sunfish, sculpin, roach, sucker, stickleback, bullfrog, and crayfish.

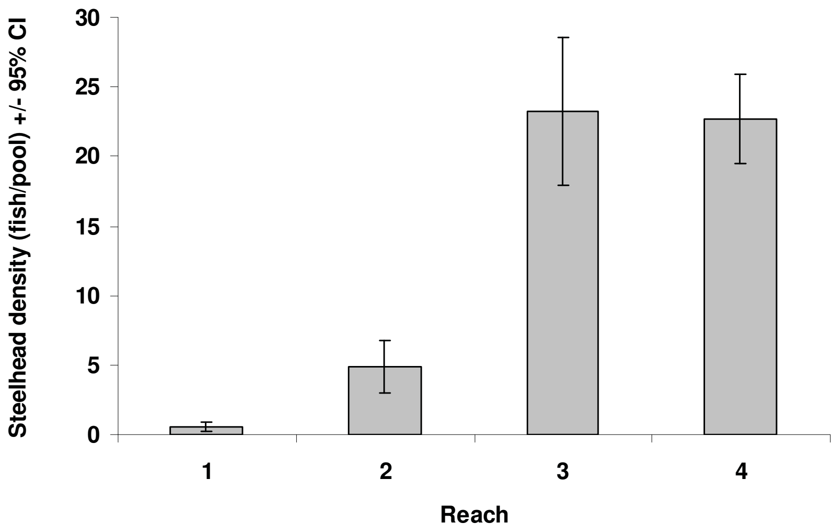


Figure 11. Numbers of steelhead observed per reach during presence/absence snorkel surveys in Green Valley Creek.

The second reach extended from the Highway 116 Bridge to the first Green Valley Road Bridge (**Figure 10**). Due to poor visibility, the pools between the Highway 116 Bridge and the mouth of Atascadero Creek were not snorkeled. Upstream of Atascadero Creek, 20 pools were snorkeled. Although fewer pools were snorkeled in this reach, 98 steelhead (**Figure 10 and 11**) were observed and steelhead densities averaged 4.9 +/- 1.9 steelhead/pool. Sculpin, roach, stickleback, bluegill, and mosquitofish were also present.

Reach three included the area between the first Green Valley Road Bridge and Bones Road Bridge (**Figure 10**). During the flood on January 1, 2006, a new channel was created at the beginning of this reach. The stream channel now consists of little vegetation, no canopy, and large quantities of algae, and was therefore not possible to snorkel. The survey continued upstream of Purrington Creek where 47 pools were snorkeled. In this reach, 1,092 steelhead were counted and steelhead densities averaged 23 +/- 18 steelhead/pool (**Figure 10 and 11**). The most varied species composition was also seen here and included roach, stickleback, green sunfish, sculpin, pikeminnow, hardhead, crayfish, and bluegill.

Sixty-four pools were snorkeled in the upper reach, which spanned from Bones Road Bridge to the second Green Valley Road Bridge. We counted 1,452 steelhead in this reach and steelhead densities averaged 23 +/- 13 steelhead/pool (**Figure 10 and 11**). Sculpin, bluegill, crayfish, and stickleback were also present. Seven freshwater shrimp were observed while snorkeling the upstream end of this reach.

Dutch Bill Creek

Dutch Bill Creek has one documented year-class of wild coho salmon that returned during the winter of 2004-2005 and were expected to return again during the winter of 2007-2008. Evidence of this single year-class was found in 2005 during presence/absence snorkel surveys (Obedzinski et al. 2007); 118 wild coho yoy were observed. During July 17-20, 2006, two consecutive reaches were snorkeled (**Figure 12**) and no coho yoy were observed.

The first reach began at the confluence with the Russian River and the second reach ended at river km 7.4 (**Figure 12**). In reach one, 38 pools were surveyed, 171 steelhead were counted and steelhead densities averaged 4.7 +/- 1.5 steelhead/pool. Other species observed include threespine stickleback, sculpin, roach, bluegill, green sunfish, bullfrog tadpoles, and pikeminnow. In the second reach, 48 pools were snorkeled, 238 steelhead were observed and steelhead densities were 5.7 +/- 1.6 steelhead/pool. Sculpin and Sacramento sucker were also observed.

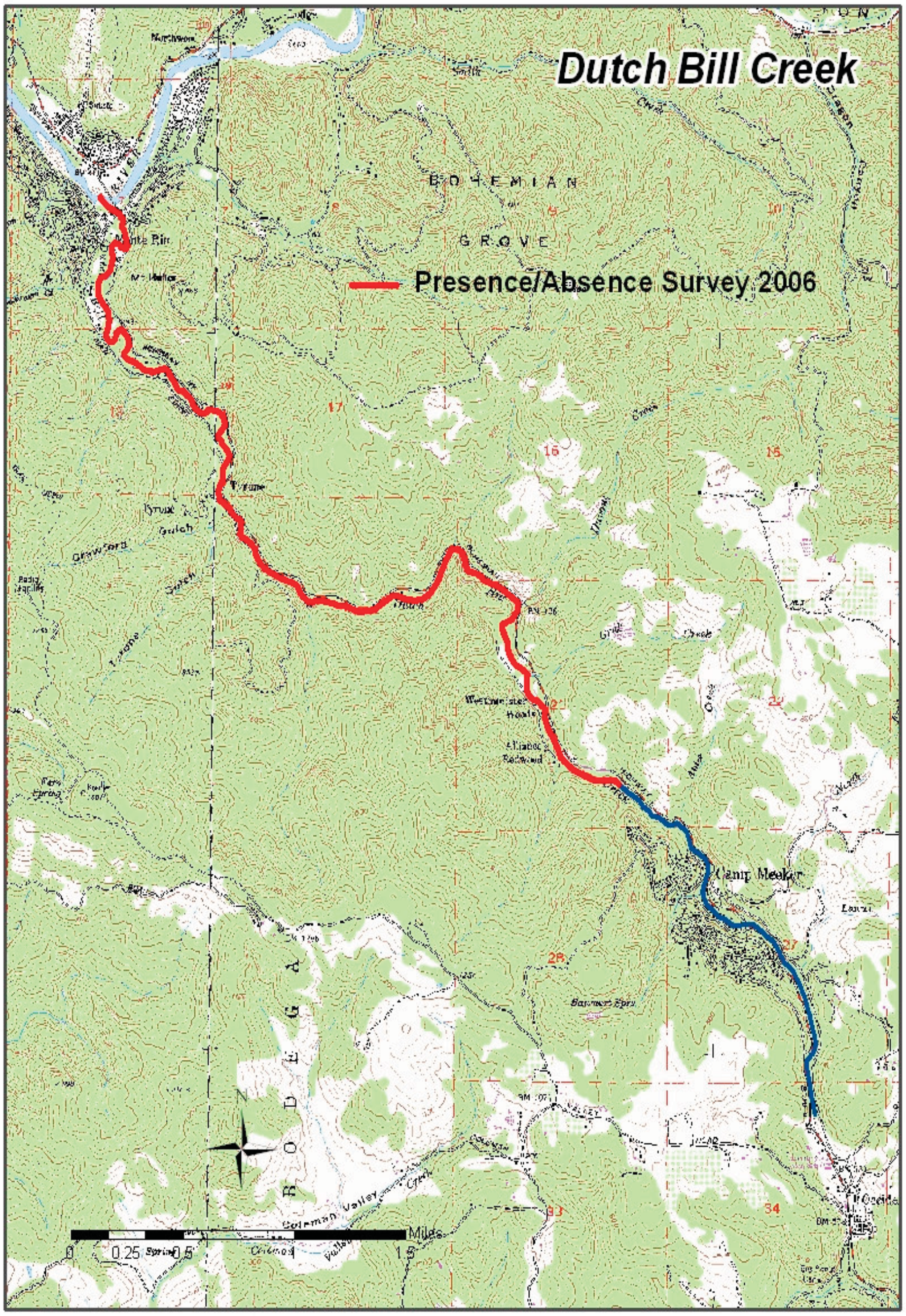


Figure 12. Dutch Bill Creek Presence/Absence Survey reach map with Reach 1 beginning at the mouth and Reach 2 ending at the south side of Alliance Redwoods Retreat Center.

ADULT RETURNS

During the winter season (November – March), adult salmonid spawner and redd surveys were completed on Mill, Felta, Palmer 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.

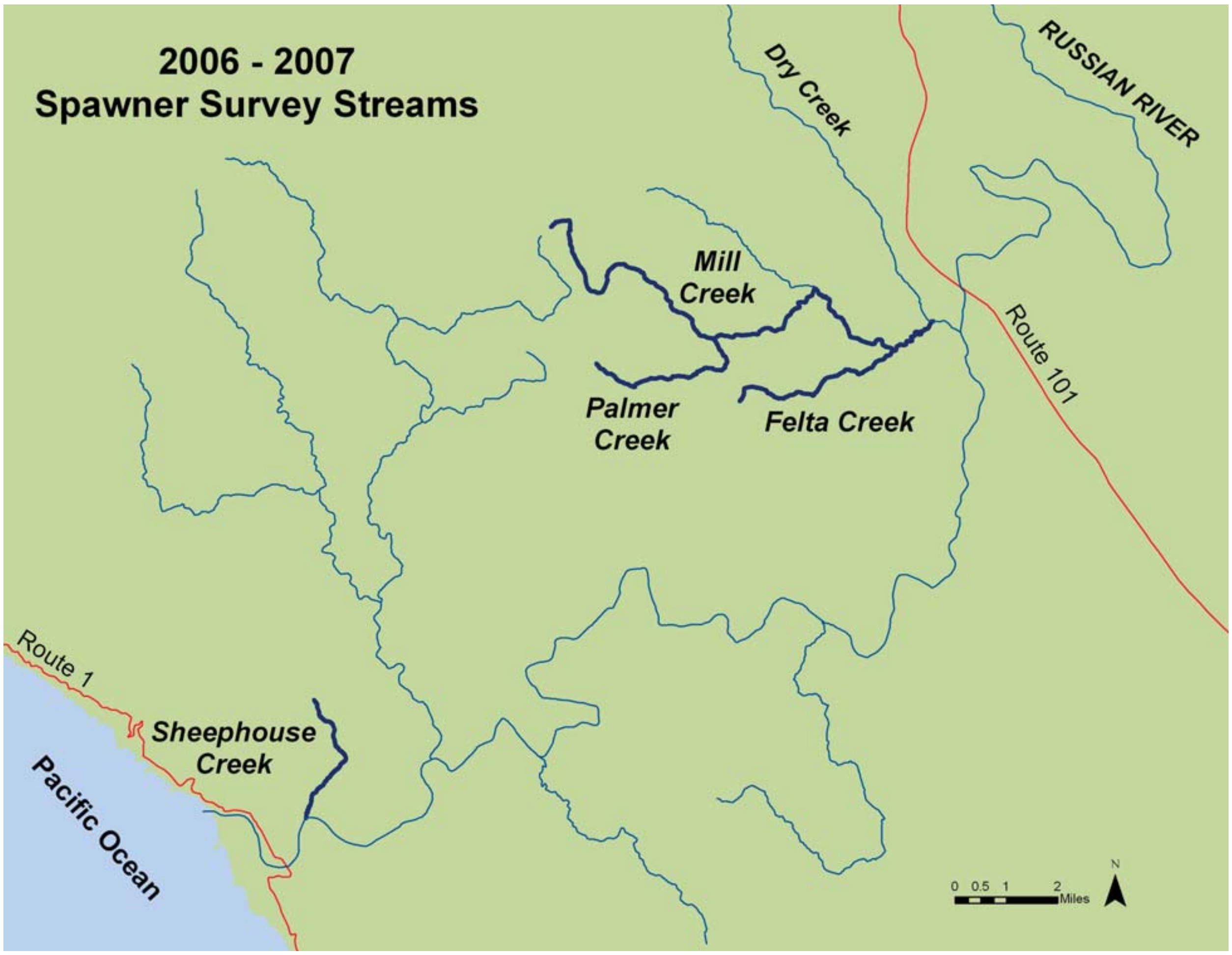


Figure 13. Redd and spawner survey streams for the winter 2006-2007 season.

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. Creeks were surveyed weekly but postponed when flows became too high to effectively observe fish and redds. Delayed surveys were completed as soon as flows subsided to safe and viewable levels. 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. Mill Creek consisted of four reaches beginning at its confluence with Dry Creek and extending upstream to the mouth of Angel Creek. The lengths of Mill Creek's four reaches ranged from 2.47 km to 4.24 km, totaling 13.50 km. Felta (1.87 km), Palmer (2.12 km) and Sheephouse Creeks (3.55 km) all consisted of one reach each due to their shorter stream length. Mill Creek reach one and Felta Creek reach one were typically surveyed on the same day by one crew due to their short length and close proximity.

Field procedures and data collection for spawner and redd surveys followed methods found in "Redd Counts" (Gallagher et. al 2007). This includes redd area and substrate measurements, flagging and monitoring redd ages, flow measurements, mapping redd locations (GPS), species identification, sex and origin (wild or adipose-clipped), and redd species identification. If a redd was devoid of fish, it was identified to species when possible using redd size and dimensions, substrate size and spawn timing as classification factors. If we were still unable to classify a redd, we used logistic regression analysis equations (Gallagher and Gallagher 2005) to discriminate between Chinook, coho or steelhead redds.

Results

Mill Creek

The first week of spawner surveys on Mill Creek occurred during the week of 12/11/06 and covered reaches one through three. Prior to this week, the mouth of the creek was dry at it's confluence with Dry Creek. A total of 40 surveys were conducted between 12/11/06 and 3/12/07 (**Table 10**). At least one reach was surveyed each week throughout this period with the exception of the week of 12/25/06, which was not surveyed due to high flow and low visibility conditions. High flows receded quickly and were reduced to 6 cfs or less during the weeks of 1/8/07 through 2/5/07. Rainfall came a few days later bringing flow up to 17.4 cfs, observed in reach one on 2/8/07. Surveys in Mill Creek ended the week of 2/26/07, with the exception of two additional surveys in reach one through 3/12/07.

One live coho salmon was observed in Mill Creek during the 2006-2007 spawner survey season (**Table 10**). It was observed on 12/14/06 during a survey of reach one. Confirmation of species, sex and hatchery-origin (adipose-clipped) occurred on 12/15/06 during a brief snorkel survey of the area. During the time of the survey on 12/14/06, the adult coho salmon female was observed digging on an unfinished (test) redd, with a jack (~35 cm) of an unknown species. The jack was not observed during the snorkel survey on 12/15/06. On 12/19/06, the same adult coho (**Figure 14**) was observed as a carcass (likely river otter predation), approximately 200 m upstream of where it was first observed. The fish was 65 cm (~7-8 lbs.) and we could not determine whether it had spawned because a predator had consumed all of the entrails. The coded-wire tag (CWT) was recovered and we confirmed that this fish was released into Mill Creek during the fall stocking in 2004.

Table 10. Results from 2006-2007 redd and spawner surveys.

	Mill Creek					Felta Creek					Palmer Creek					Sheephouse Creek				
Week of	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	Reaches Surveyed	Live Coho	Coho Redds	Live Sthd	Sthd Redds
27-Nov	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns	1	0	0	0	0
4-Dec	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns	1	0	0	0	0
11-Dec	3	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
18-Dec	3	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
25-Dec	0	ns	ns	ns	ns	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
1-Jan	4	0	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
8-Jan	4	0	0	0	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
15-Jan	4	0	0	0	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
22-Jan	4	0	0	0	1	0	ns	ns	ns	ns	0	ns	ns	ns	ns	1	0	0	0	0
29-Jan	4	0	0	0	0	0	ns	ns	ns	ns	0	ns	ns	ns	ns	1	0	0	0	0
5-Feb	2	0	0	3	0	0	ns	ns	ns	ns	0	ns	ns	ns	ns	1	0	0	0	0
12-Feb	3	0	0	6	7	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
19-Feb	4	0	0	12	4	1	0	0	0	0	1	0	0	0	0	1	0	0	1	1
26-Feb	3	0	0	2	0	0	ns	ns	ns	ns	0	ns	ns	ns	ns	0	ns	ns	ns	ns
5-Mar	1	0	0	3	3	1	0	0	0	2	1	0	0	0	0	1	0	0	0	0
12-Mar	1	0	0	1	5	0	ns	ns	ns	ns	1	0	0	2	3	1	0	0	0	2
TOTALS	**40**	**1***	**1****	**28*****	**22**	**9**	**0**	**0**	**0**	**2**	**10**	**0**	**0**	**2**	**3**	**15**	**0**	**0**	**1**	**3**

ns - Indicates that spawner surveys were not conducted due to low flows (mouth closures) or high flows (high turbidity).
* One female adipose clipped coho (65cm, ~7-8 lbs.) was observed in lower Mill Creek on 12/14/06. It was found again on 12/19/07.
as a carcass (river otter predation). Processing of the CWT confirmed it was a program fish that was released in Mill Cr. (Fall of 2004).
** The one coho redd observed during the week of 1/1/07 on Mill Creek did not have fish on it.
*** Live steelhead numbers have not been corrected for possible double counts.

Additional Notes

1. One live adult male chinook was observed in lower Mill Creek on 2/19/07.
2. Redds/Live fish observed during the week of 3/12/07 were not measured. These redds/live fish were found incidentally during other work.

Figure 14. Mill Creek female coho salmon carcass found on 12/19/08.

A total of 28 live adult steelhead were observed during the 2006-2007 spawning season on Mill Creek (**Table 10**). In reaches one through four, we observed 12 (including one jack), 11, five and zero live adult steelhead, respectively. Of these 28 adult steelhead, 12 were male, nine were female and seven were of unknown sex. Adipose fins were observed on 15 of the steelhead indicating their wild origin, one was adipose-clipped indicating its hatchery origin and 12 were of unknown origin. In addition, one live male Chinook salmon was observed in reach one on 2/19/08. No steelhead carcasses were observed during the spawning season.

One coho redd was observed, in reach three on 1/3/07, in Mill Creek (**Table 10**). This redd was classified both by the original crew and logistic regression analysis equations found in Gallagher and Gallagher (2005), as a coho redd. No adults were observed on or near this redd and no juveniles were found in the vicinity during presence/absence snorkel surveys the following spring/summer. A total of 22 steelhead redds were observed in Mill Creek (**Table 10**) with reaches one through four having 12, two, three and five redds, respectively (**Figure 15 through 20**).

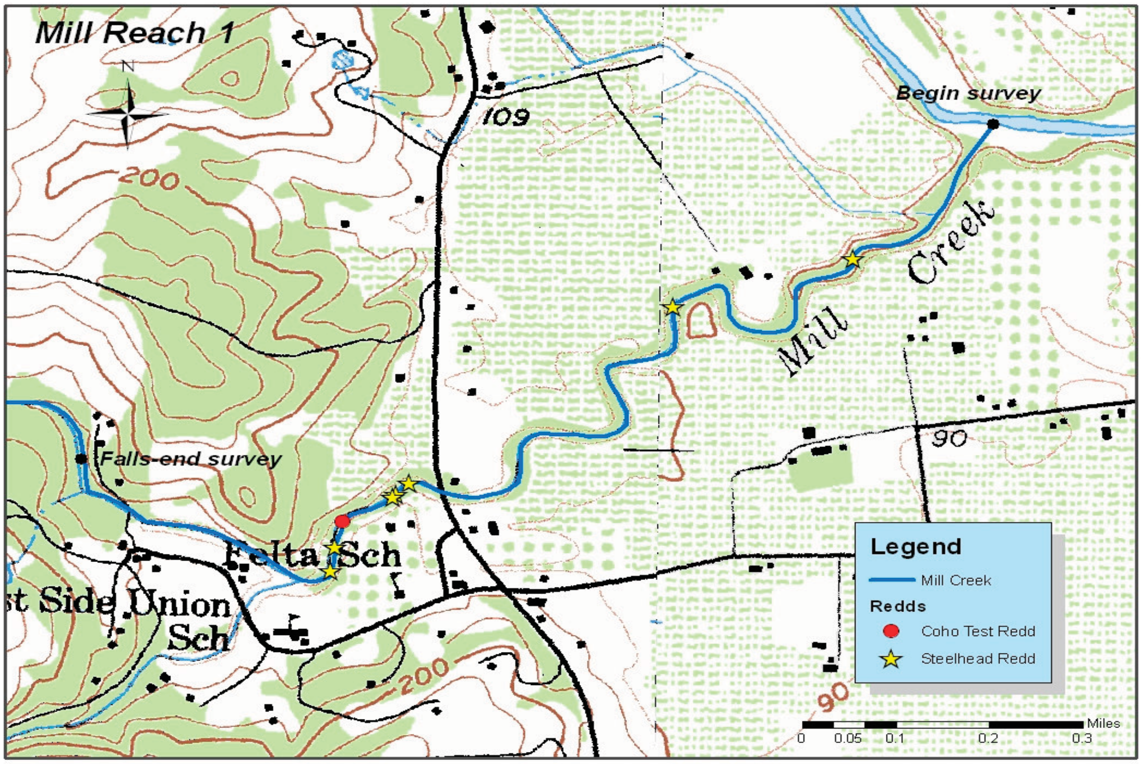


Figure 15. Coho and steelhead redds observed in Mill Creek spawner/redd survey reach 1 during winter 2006-2007.

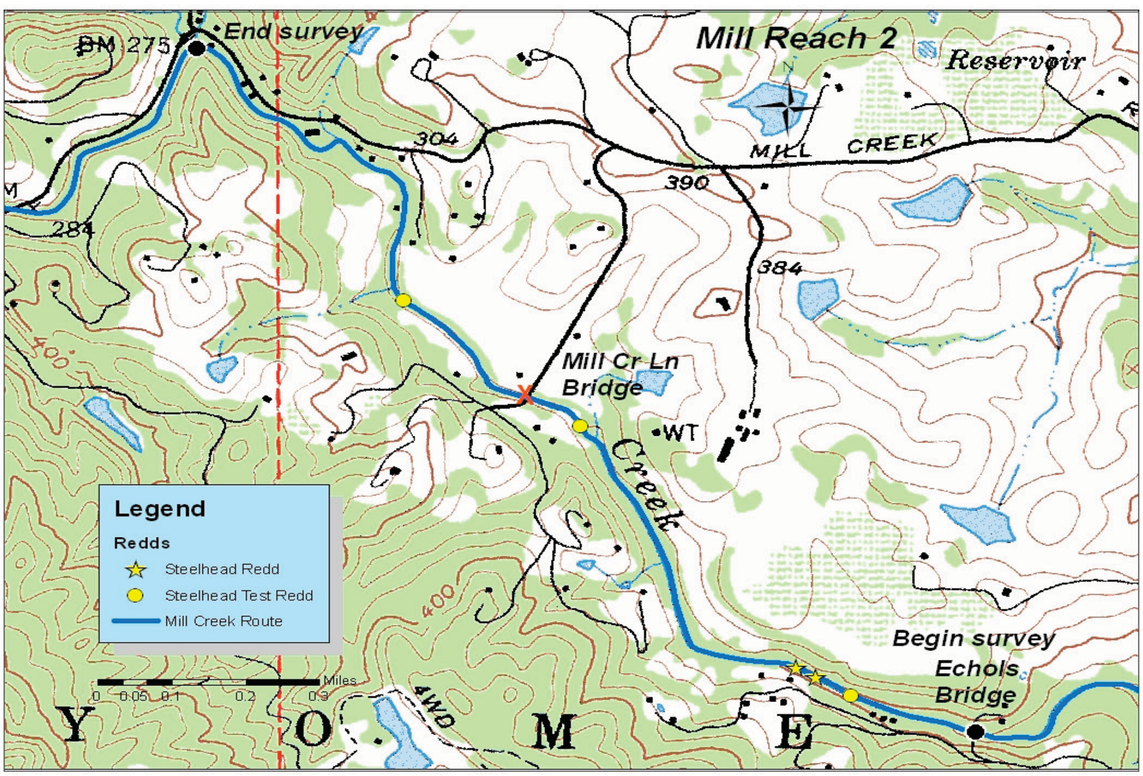


Figure 16. Steelhead redds observed in Mill Creek spawner/redd survey reach 2 during winter 2006-2007.

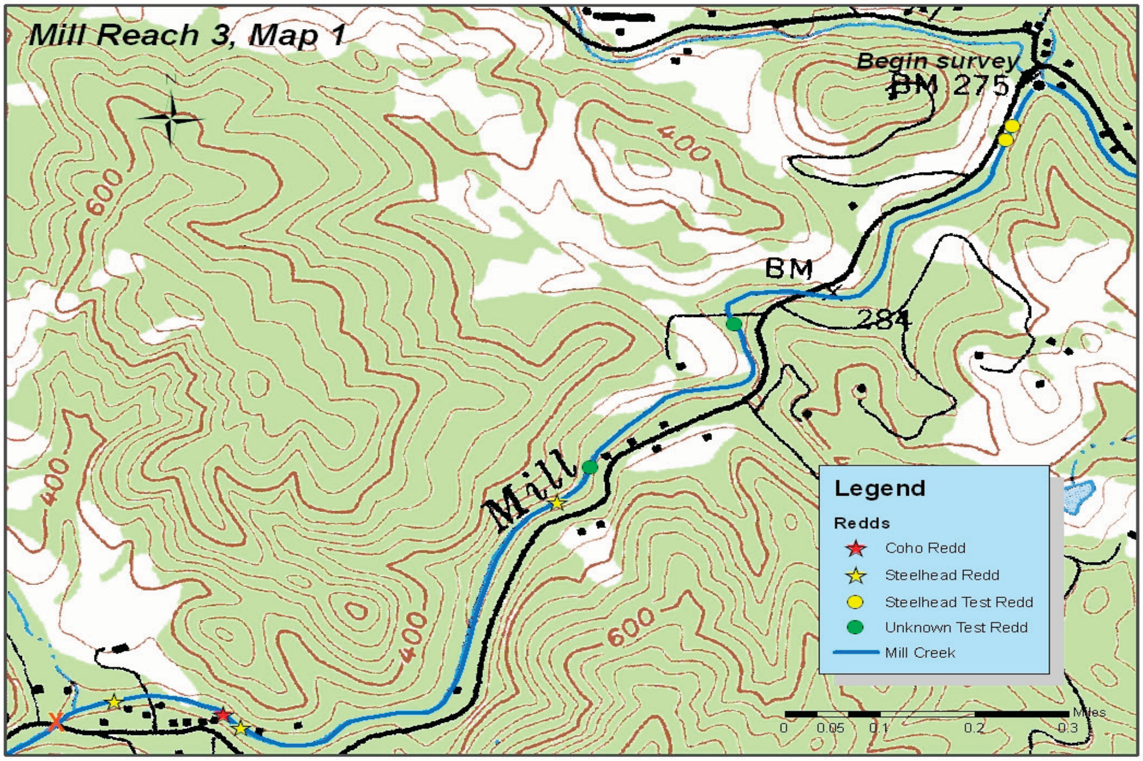


Figure 17. Coho and steelhead redds observed in Mill Creek spawner/redd survey reach 3, map 1 during winter 2006-2007.

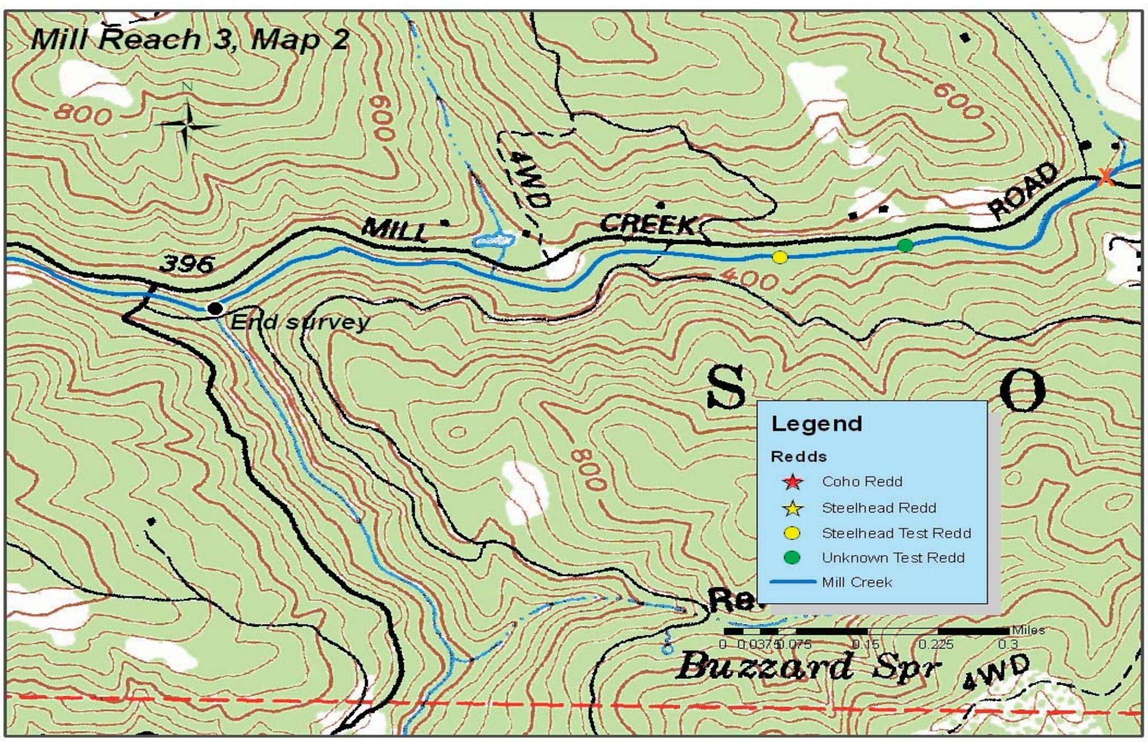


Figure 18. Coho and steelhead redds observed in Mill Creek spawner/redd survey reach 3, map 2 during winter 2006-2007.

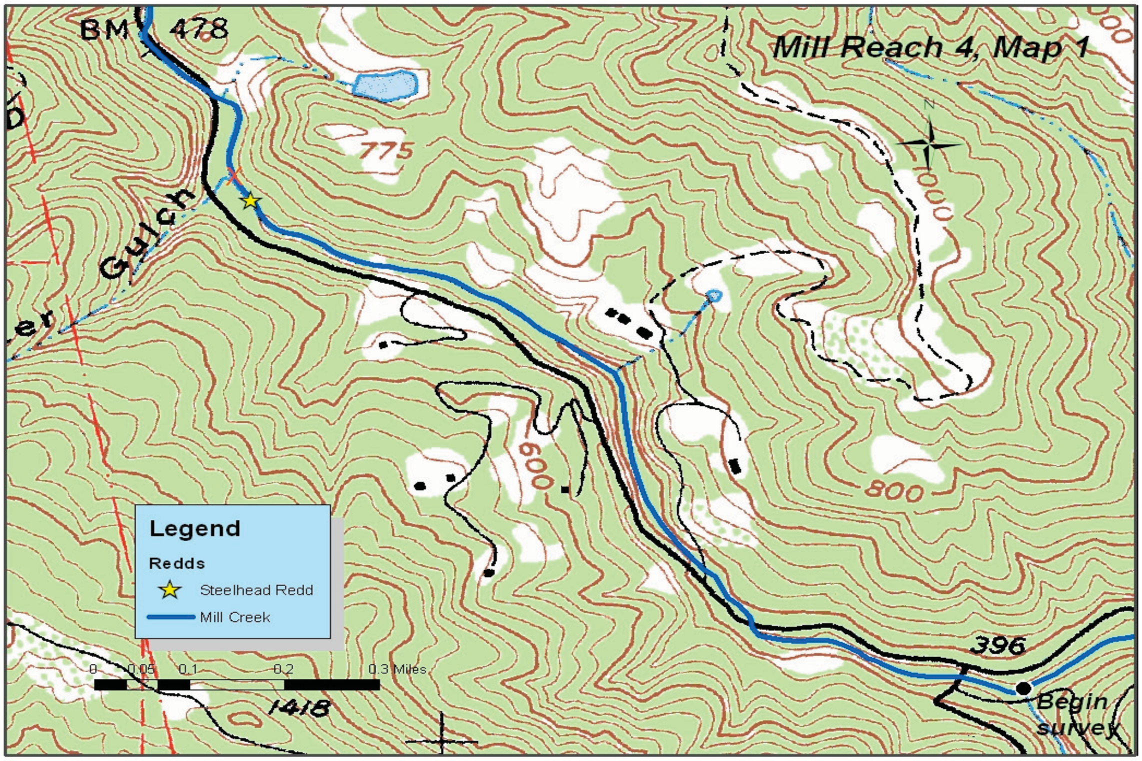


Figure 19. Steelhead redds observed in Mill Creek spawner/redd survey reach 4, map 1 during winter 2006-2007.

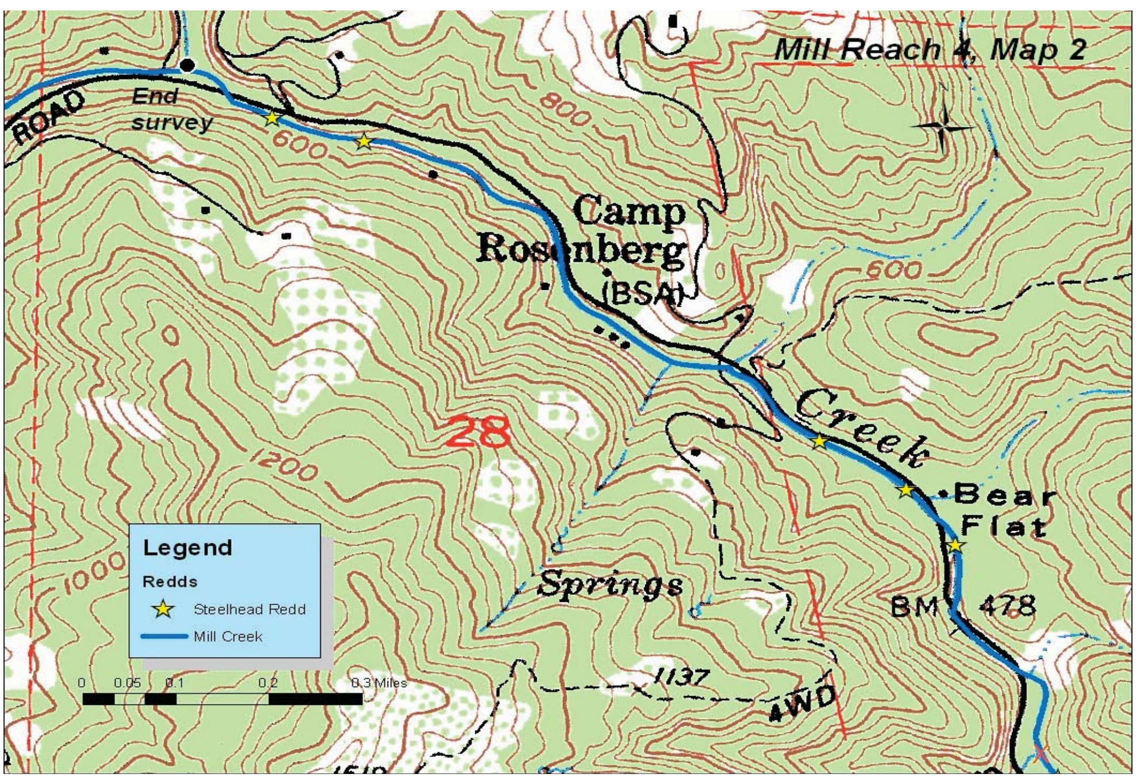


Figure 20. Steelhead redds observed in Mill Creek spawner/redd survey reach 4, map 2 during winter 2006-2007.

Felta Creek

Spawner surveys began on Felta Creek during the week of 12/11/06, 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 nine surveys completed through the week of 3/12/07 (**Table 10**).

No live coho salmon, carcasses or redds were observed during these surveys. No steelhead or steelhead redds were observed until a survey completed during the week of 3/5/07. During that survey, two steelhead redds were observed (**Figure 21**, **Table 10**).

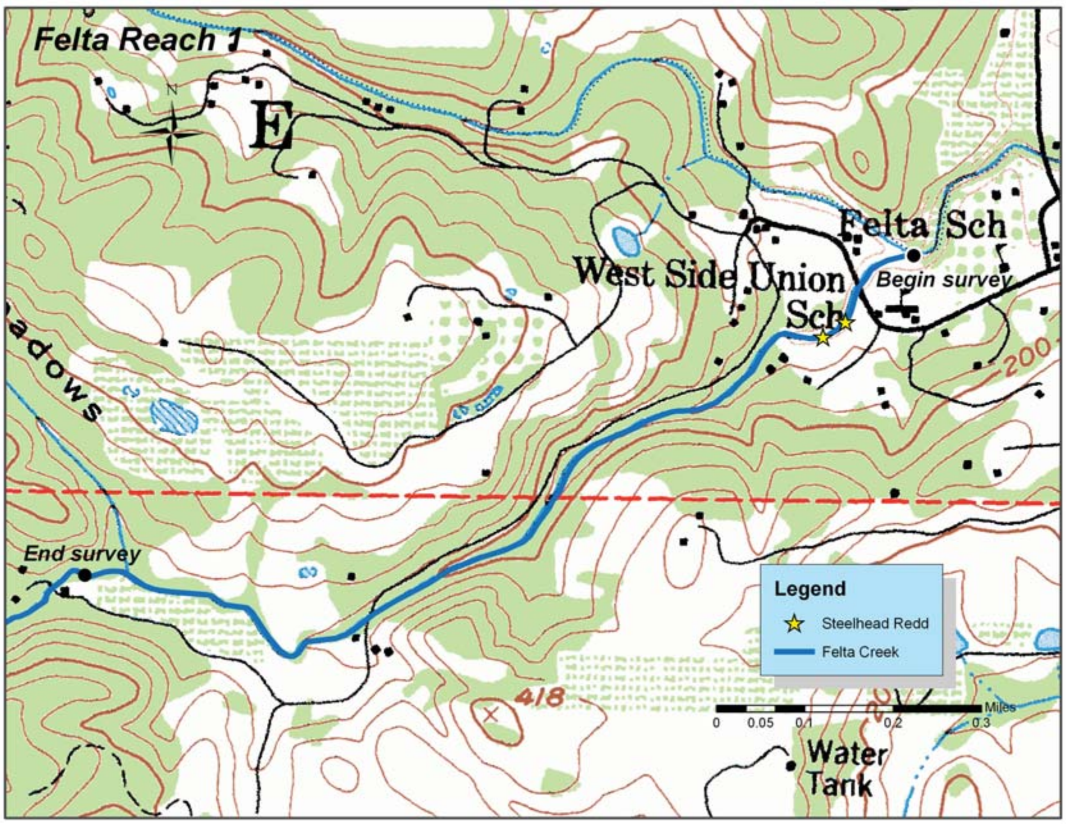


Figure 21. Steelhead redds observed in Felta Creek spawner/redd survey reach 1 during winter 2006-2007.

Palmer Creek

Spawner surveys began on Palmer Creek during the week of 12/11/06, also coinciding with rains opening the mouth of Mill Creek. Palmer is a tributary of Mill, therefore spawning adults could not access Palmer until the mouth of Mill was open. There were a total of eight surveys completed through the week of 3/12/07 (**Table 10**). The last survey during the week of 3/12/07 was incomplete and was conducted during a habitat reconnaissance for the spring 2007 release.

No live coho salmon, carcasses or redds were observed during the 2006/2007 spawning season on Palmer Creek (**Figure 22**, **Table 10**). No live steelhead, carcasses or steelhead redds were observed during complete spawner surveys from 12/11/06 through 3/5/07 (**Figure 22**). During the partial survey the week of 3/12/07, two live steelhead and three steelhead redds were observed (**Table 10**). The two steelhead were a male and a female and were both of wild origin.

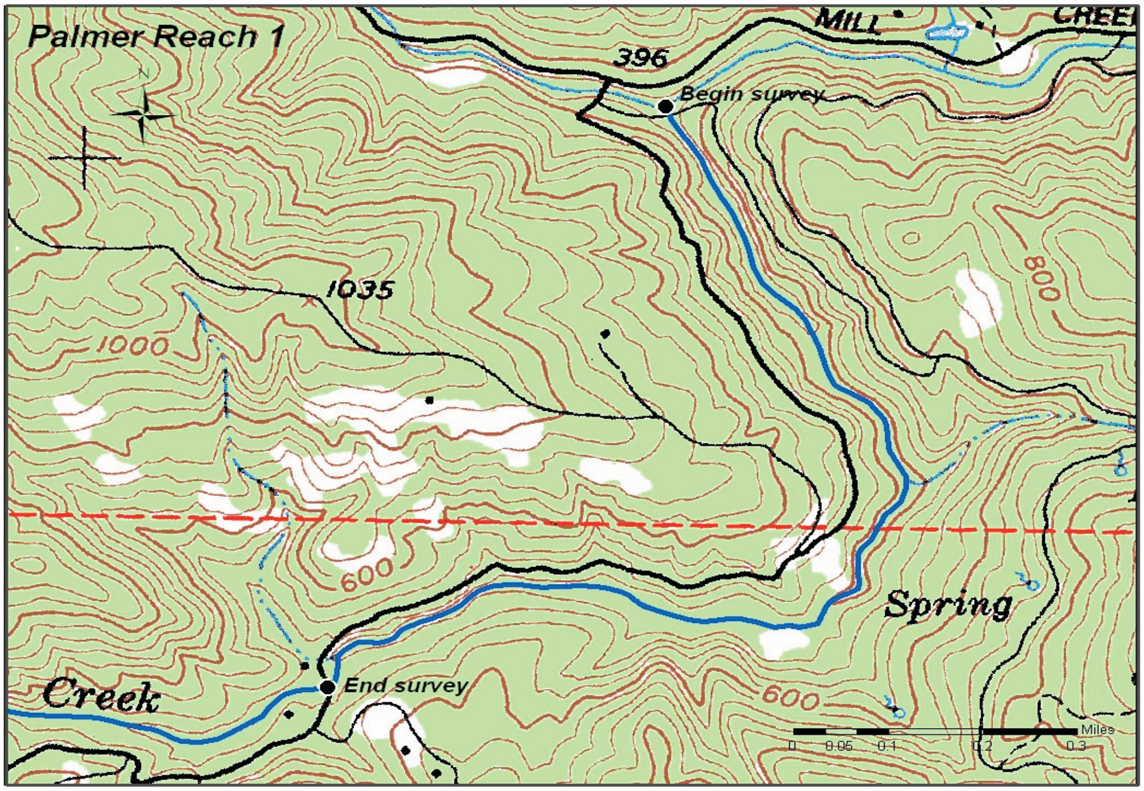


Figure 22. Palmer Creek spawner/redd survey reach 1. No redds were observed during complete surveys through the weeks of 12/11/06 – 3/5/07. Three steelhead redds were observed near the end of the reach during a partial survey the week of 3/12/07 during a habitat reconnaissance for the spring 2007 release.

Sheephouse Creek

Spawner surveys began on Sheephouse Creek during the week of 11/27/06 and continued through the week of 3/5/07. Although flows were low throughout the season, 15 surveys were completed with the exception of the week of 2/26/08 (**Table 10, Figure 23 and 24**). An incomplete survey was conducted during the week of 3/12/07 while scouting the creek for the upcoming spring juvenile stocking.

No live coho salmon, carcasses or redds were observed during these surveys (**Table 10, Figure 23 and 24**). A total of one steelhead and three steelhead redds were observed through the week of 3/12/07. The one steelhead adult observed was a wild female which was on a redd.

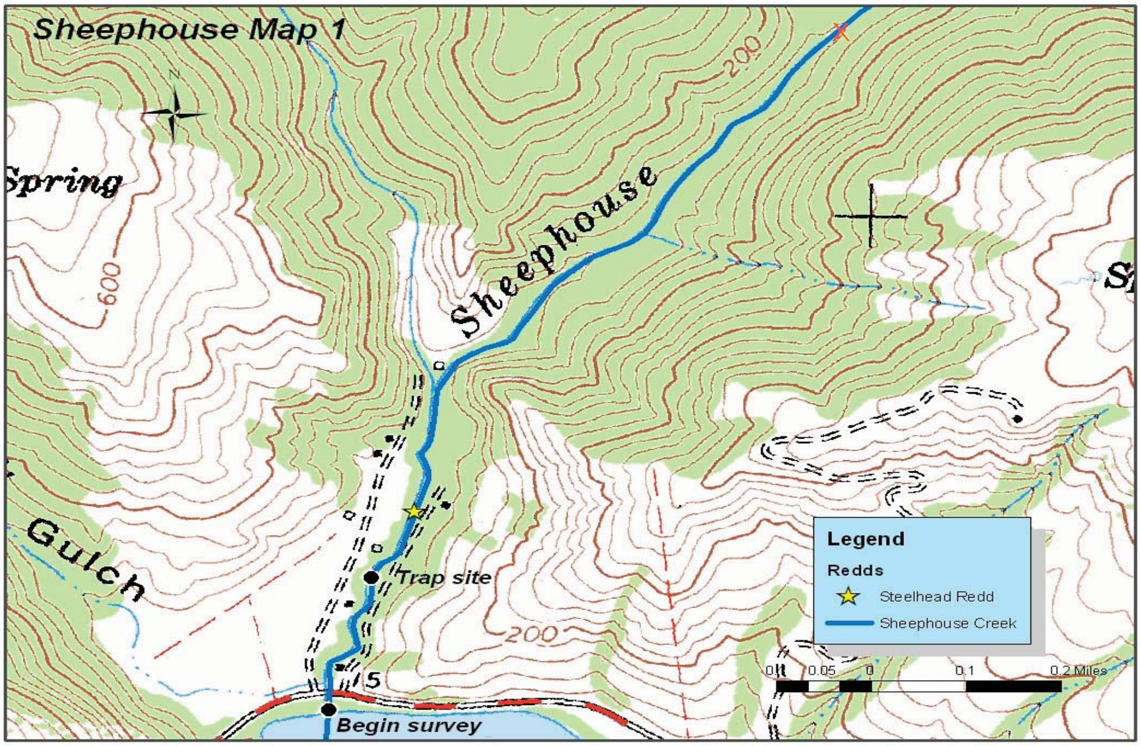


Figure 23. Steelhead redd observed in Sheephouse Creek spawner/redd survey reach 1, map 1 during winter 2006-2007. Two additional steelhead redds were observed the week of 3/12/07 in the vicinity of the first during a partial survey for the upcoming spring 2007 release.

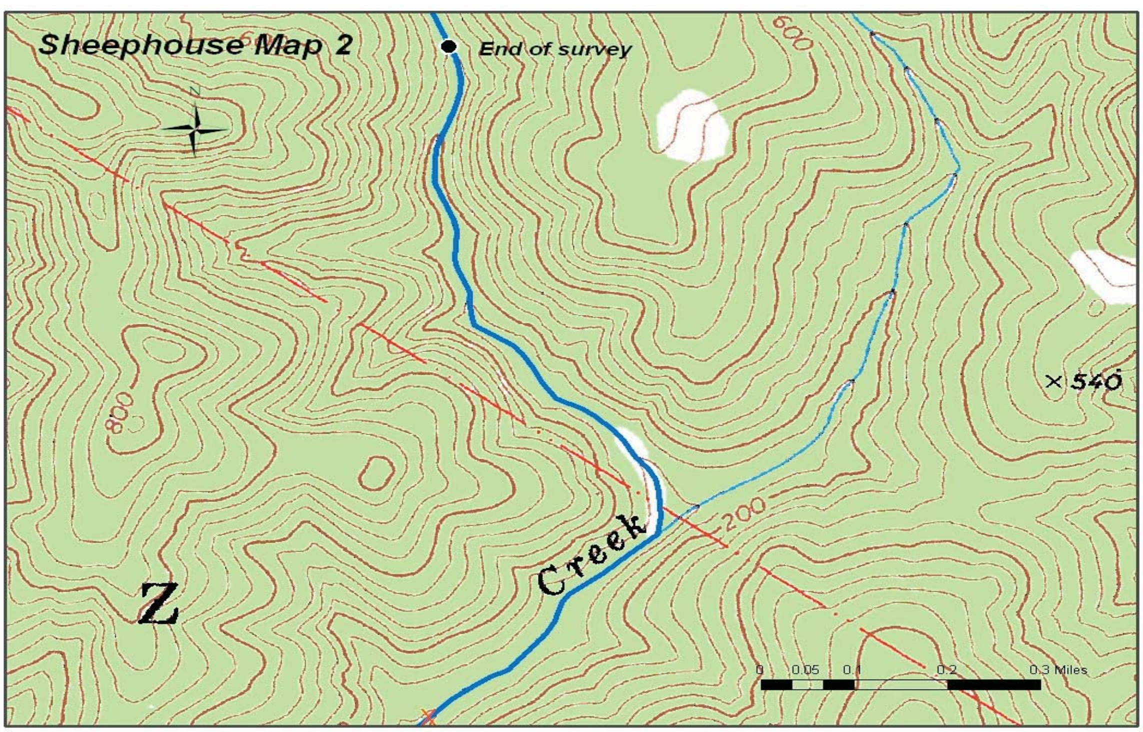


Figure 24. Sheephouse Creek spawner/redd survey reach 1, map 2. No redds were observed for this part of reach 1.

OVERWINTER SURVIVAL ESTIMATES

During the spring season (March-June), downstream migrant traps were operated on Mill, Sheephouse, Ward, and Green Valley Creeks, (**Figure 25**). 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, Palmer, and Sheephouse Creeks. Secondary objectives were to estimate the number of steelhead smolts emigrating from each creek during the trapping season, collect genetic samples from coho and steelhead, and count all other fish and amphibian species captured in the traps.

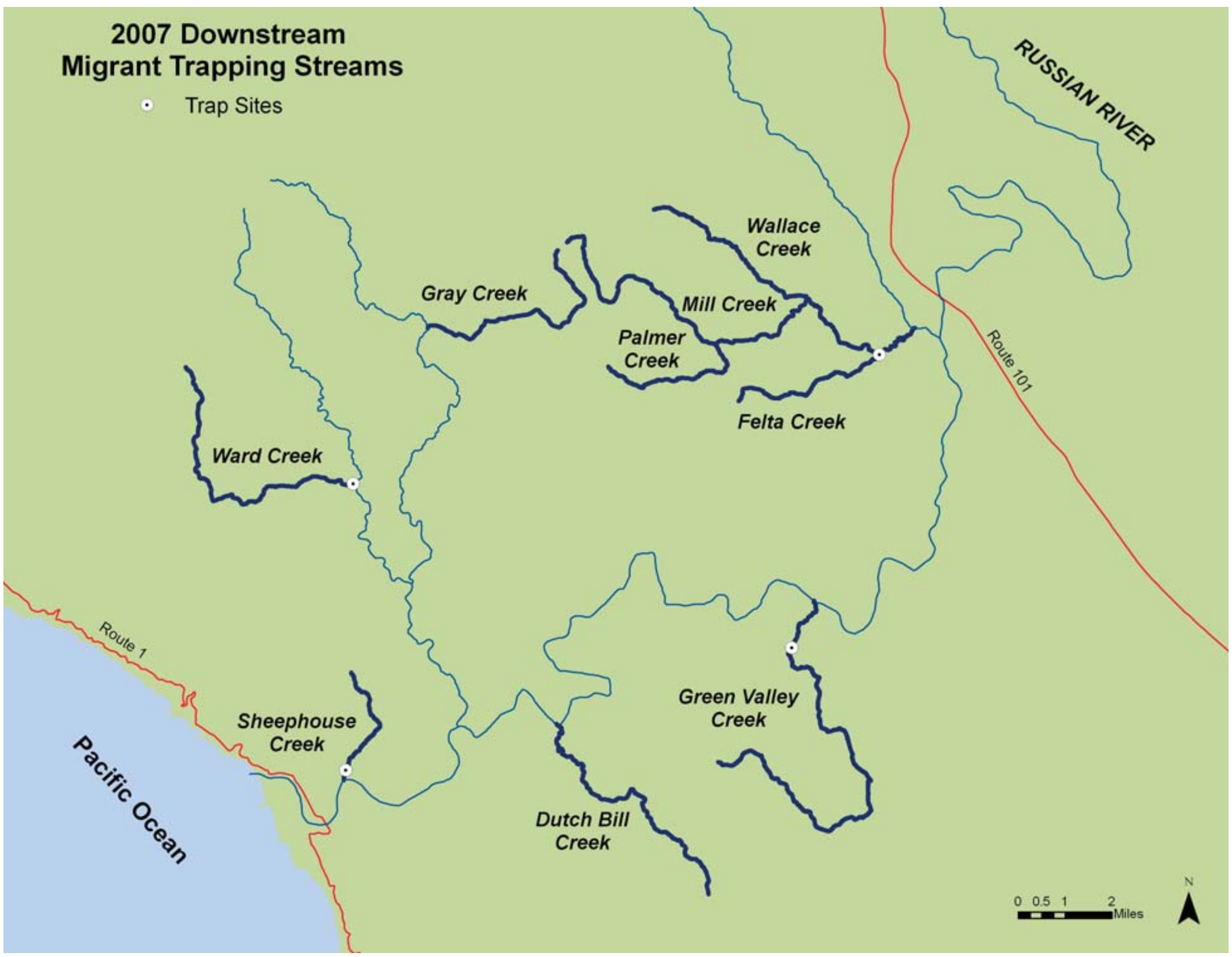


Figure 25. Spring 2007 downstream migrant trap locations on streams stocked with coho yoy in 2006.

Methods

Funnel net traps were used on Mill (3/13-5/24), Ward (3/16-6/1), and Green Valley Creeks (3/17-6/15) (**Figure 26a**). A pipe trap was used on Sheephouse Creek (3/14-6/15) and on Mill

Creek (5/25-6/15) when flows dropped significantly in the spring (**Figure 26b**). 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 3'x 4' 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 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, scanned with a coded-wire detection wand to determine presence and location of a coded-wire tag (CWT) and visually inspected for the presence of a visual implant elastomer (VIE) tag. CWT location and VIE tag color was later used to determine the stream and season that the fish was 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 study, 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.

a.

b.

Figure 26. Trap designs used on Green Valley Creek (a) and Sheephouse Creek (b) in 2007. The funnel trap used on Green Valley Creek was similar to trap design used on Mill and Ward Creeks 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 2007, the Mill Creek and Sheephouse Creek traps were installed on 3/12 and 3/13 respectively, and fished through 6/15, for a total of 95 and 94 days fished, respectively. The Ward Creek trap was installed on 3/15 and fished through 6/1, with the exception of 4/23-4/24 due to high flows, for a total of 76 days fished. The Green Valley Creek trap was installed on 3/16 and fished through 6/15, with the exception of 4/23-4/25, for a total of 88 days fished. Traps were checked seven days a week by UCCE staff with the assistance of CDFG staff, and AmeriCorps volunteers. During the trapping period, average weekly trap efficiencies were 0.72 on Mill Creek (range 0.38 to 0.86), 0.75 on Ward Creek (range 0.49 to 0.88), 0.37 on Green Valley Creek (range 0.22 to 0.42), and 0.52 on Sheephouse Creek (range 0.52 to 0.52; all weeks of trapping strata were pooled due to low number of recaptures).

Salmonid trap counts and run-timing

In 2007, a total of 2,922 program coho smolts were captured in Mill, Green Valley, Sheephouse and Ward Creeks combined (**Table 11**). Three wild coho smolts were captured during the 2007 season, one each in the Mill, Green Valley and Sheephouse traps. We believe the origin of the wild coho smolt caught in the Mill Creek trap is from adults that spawned in Felta Creek in the winter of 2005-2006. The origin of the other two wild fish caught in the Green Valley and Sheephouse traps is unknown, but we do not believe it is from either of these creeks because no coho salmon yoy were observed during extensive presence/absence snorkel surveys in these streams the previous summer.

All program coho released in 2006 received a CWT tag in the snout and/or adipose region (**Table 12**). In Mill and Palmer Creeks, fall released fish additionally received either a red (Mill) or green (Palmer) VIE tag in the caudal fin. Tag detections were used to determine the stream and season of stocking for downstream migrating coho smolts. During fish processing at the downstream migrant traps, a total of 2,892 coho smolts were scanned with a CWT detection wand and visually scanned for presence of a red or green VIE tag (**Table 13**). CWT locations of fish in a given tributary that did not match the locations of fish that were released in that tributary (e.g. CWT location SA in Green Valley when no SA fish were released in Green Valley) represent misclassifications, tag loss, or potential movements among tributaries. Overall CWT detection for fish captured in all streams was 99% with a minimum misclassification rate of 2%. VIE detection was 70%, and we suspect that this rate differed between colors/locations based on data collected on tagged coho held at Warm Springs Hatchery (Louise Conrad unpublished data).

In addition to coho smolts, a total of 318 steelhead smolts (33 hatchery), 3,132 steelhead yoy/parr, 60 steelhead adults (50 wild, 8 of hatchery origin, 2 of unknown origin), 228 Chinook yoy, and two wild coho yoy (origin believed to be in the Mill Creek system) were captured in the traps in 2007 (**Table 11**).

In 2007, the first coho smolts were captured on the first day of trapping on Mill Creek (3/13), and the last coho were captured on 6/12 on both Mill and Green Valley Creeks (**Figure 27**). As

Table 11. Number, species, and life stage of wild (W) and hatchery (H) salmonids captured in downstream migrant traps during spring 2005, 2006, and 2007.

		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	24	0	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

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

[2] 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 12. Tagging strategies by stream and season for 2004, 2005, and 2006 coho releases into Russian River tributaries. Locations for CWT are as follows: S=snout, A= adipose region, SA=snout and adipose region.

		Spring	Fall	
Release Year	Tributary	CWT Location	CWT Location	VIE
2004	Mill	*no stocking*	S	*none*
2004	Sheephouse	*no stocking*	S	*none*
2004	Ward	*no stocking*	S	*none*
2005	Mill	*no stocking*	A	*none*
2005	Palmer	S	SA	*none*
2005	Sheephouse	*S*	A	*none*
2005	Ward	*no stocking*	A	*none*
2005	Gray	S	SA	*none*
2006	Mill	S	SA	red upper caudal
2006	Palmer	A	SA	green lower caudal
2006	Sheephouse	S	SA	*none*
2006	Ward	S	*no stocking*	*no stocking*
2006	Gray	A	SA	*none*
2006	Green Valley	*no stocking*	S	*none*
2006	Dutch Bill	*no stocking*	S	*none*

Table 13. Number of CWT and VIE detections in scanned program coho smolts, spring 2007. Locations for CWT are as follows: S=snout, A= adipose region, SA=snout and adipose region, NT=no tag found, Total=total smolts scanned for CWT and VIE.

	No VIE					Red VIE					Green VIE				
Tributary	**S**	**A**	**SA**	**NT**	**Total**	**S**	**A**	**SA**	**NT**	**Total**	**S**	**A**	**SA**	**NT**	**Total**
Mill	318	156	493	5	972	11	21	852	0	884	3	5	297	0	305
Sheephouse	56	1	59	4	120	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*
Ward	119	1	2	2	124	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*
Green Valley	495	2	1	7	504	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*

in previous years, smolt migration in Ward Creek ended in late May, earlier than in the other three creeks. Clear peaks in run timing were apparent in Mill and Green Valley Creeks, with Mill smolts peaking on 5/9 and Green Valley smolts peaking almost two weeks later on 5/22. The peak run time on Mill in 2007 was similar to the peak timing in 2005. As in previous years (with the exception of Sheephouse 2005), Sheephouse and Ward showed no clear peaks in migration timing.

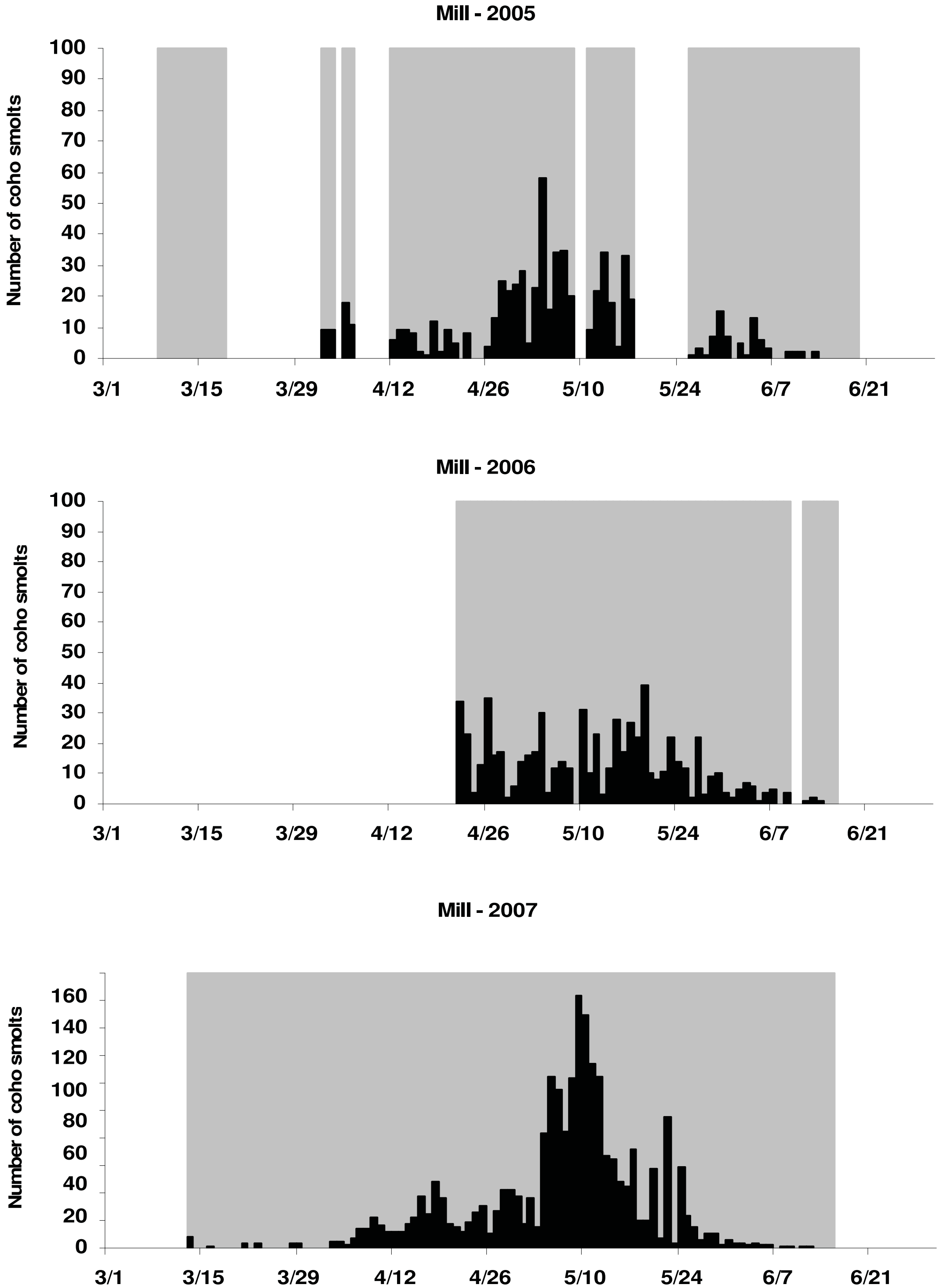


Figure 27. Number of smolts captured daily in downstream migrant traps during springs 2005 through 2007 in Russian River tributaries. Shaded background indicates days that the traps were fishing. Note the increased scale for number of smolts in Mill Creek in 2007.

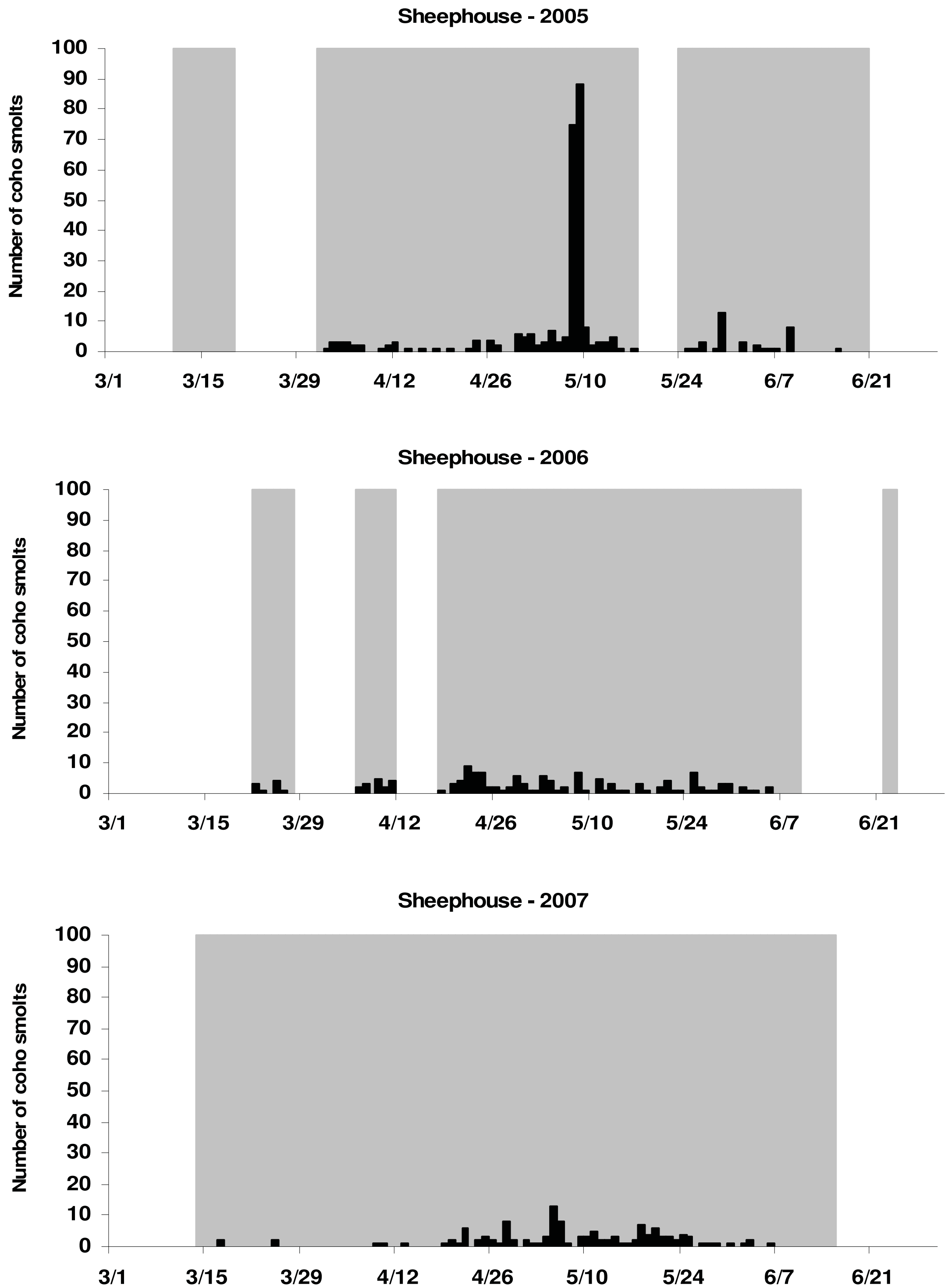
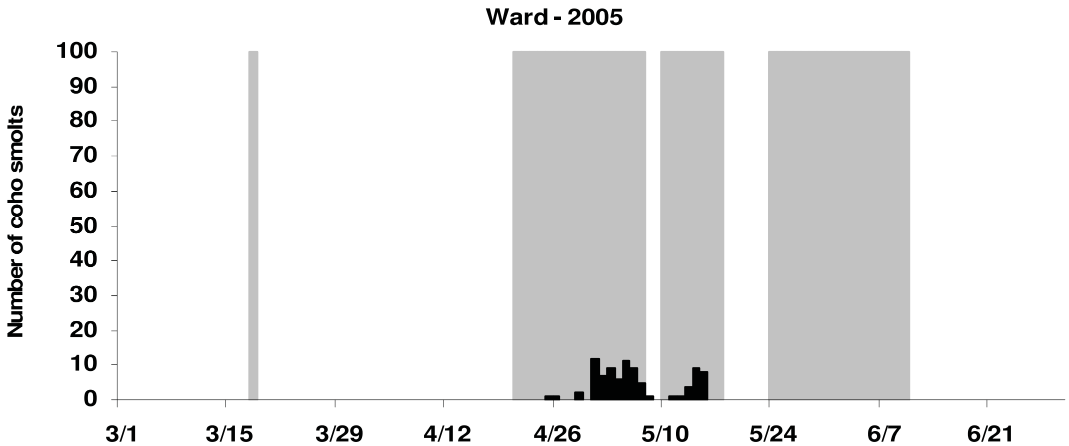
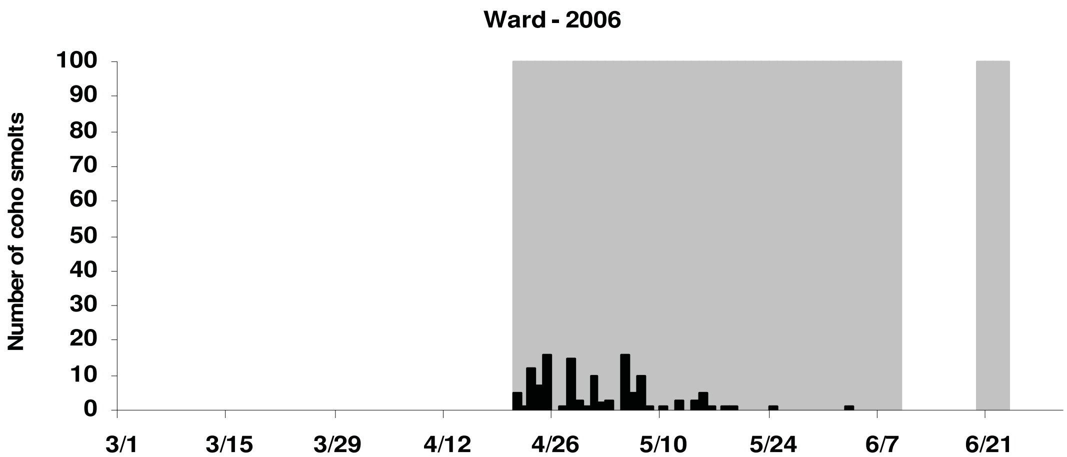


Figure 27 (cont.). Number of smolts captured daily in downstream migrant traps during springs 2005 through 2007 in Russian River tributaries. Shaded background indicates days that the traps were fishing. Note the increased scale for number of smolts in Mill Creek in 2007.





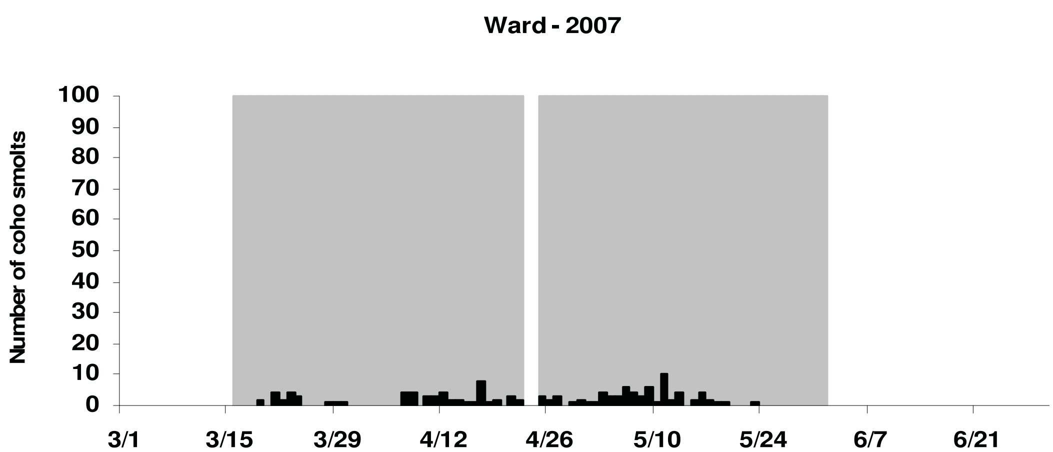
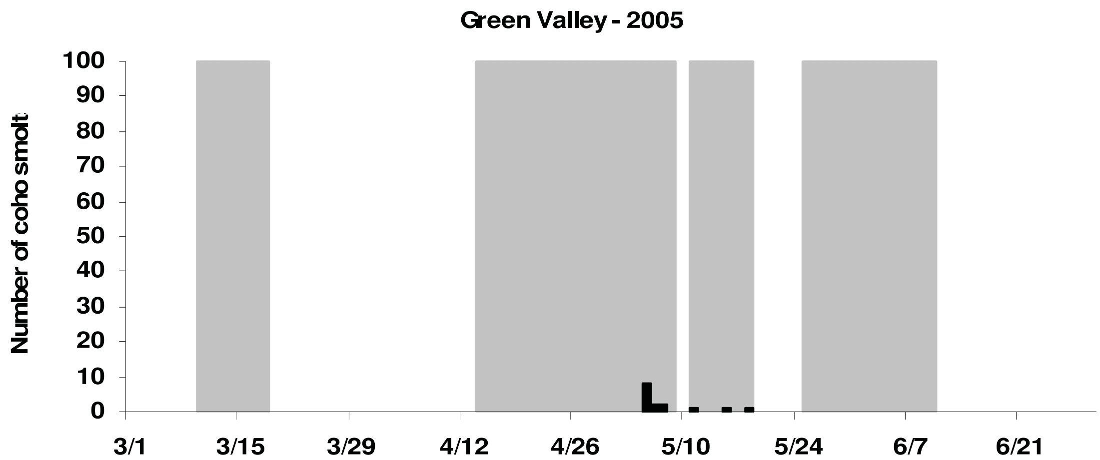


Figure 27 (cont.). Number of smolts captured daily in downstream migrant traps during springs 2005 through 2007 in Russian River tributaries. Shaded background indicates days that the traps were fishing. Note the increased scale for number of smolts in Mill Creek in 2007.



No trap operated on Green Valley in 2006

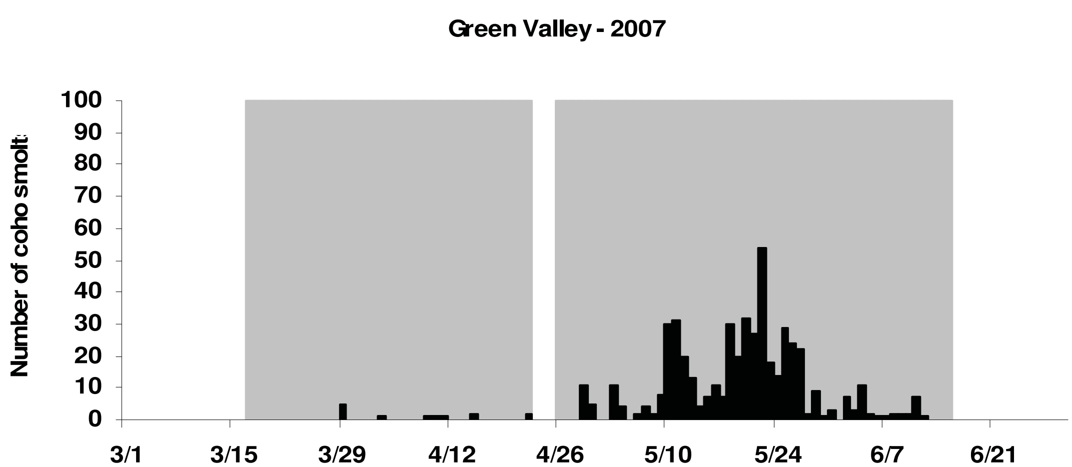


Figure 27 (cont.). Number of smolts captured daily in downstream migrant traps during springs 2005 though 2007 in Russian River tributaries. Shaded background indicates days that the traps were fishing. Note the increased scale for number of smolts in Mill Creek in 2007.

Coho abundance and overwinter survival estimates

Trap counts and smolt abundance estimates were higher in 2007 than in previous years (with the exception of Sheephouse), reflecting the increased stocking efforts in Russian River tributaries (**Table 14**). However, the increased smolt abundance estimates did not translate into increased overwinter apparent survival estimates. On average, overall overwinter apparent survival estimates of spring and fall-released fish combined were lower in 2006-2007 than in 2004-2005 and higher than in 2005-2006 (**Table 14, Figure 28**). In 2006, traps were installed later than in 2005 and 2007 due to high flows, and therefore abundance estimates and overwinter survival estimates are minimum estimates, and without such bias may have been similar to estimates in 2007. Within each year, Mill and Palmer continued to have higher overwinter apparent survival estimates than Sheephouse and Ward. Green Valley had the highest overwinter apparent survival estimate in 2007. Because spring and fall-released coho may 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 28**). When the comparisons are made in this way, estimates for Sheephouse are slightly higher in 2006 and 2007 than when estimates are made with spring and fall-released fish combined.

Comparison of spring and fall release groups

In 2006, Mill, Palmer, Sheephouse, and Gray Creeks were stocked in both the spring and fall seasons. In each creek, the estimated number of spring stocked fish that survived until the time of the fall release was compared with the number of fall stocked fish, resulting in a spring to fall proportion of 0.07 in Mill, 0.33 in Palmer, 2.04 in Sheephouse, and 0.30 in Gray (**Table 15**). The following spring, the proportion of spring to fall stocked fish captured in the downstream migrant traps was 0.27 in Mill, 0.31 in Palmer, 0.89 in Sheephouse, and 0.43 in Gray (**Table 15**). Unlike the previous year, where the proportion of spring to fall fish during the smolt migration was lower than the values in the stream at the time of fall stocking, the change in proportion from fall 2006 to spring 2007 varied by stream. In Mill and Gray the proportion of spring fish increased, in Palmer it remained approximately the same, and in Sheephouse it decreased, though not as much as in the previous year (**Table 15**).

In Palmer and Sheephouse Creeks where mark-recapture data was collected at the downstream migrant traps on both spring and fall-released coho, overwinter apparent survival estimates were higher for fall vs. spring-released fish, similar to the pattern observed during the winter of 2005-2006 (**Table 16**). During the winter of 2006-2007, however, differences in survival estimates between spring and fall groups were reduced, with Palmer spring and fall groups essentially having similar estimates. During both winters the difference between groups was greater in Sheephouse Creek than in Palmer Creek.

In 2007, timing of downstream migration between spring and fall release groups was similar on Palmer and Sheephouse Creeks (**Figure 29**). On Sheephouse, this result differed from distributions in 2006 where fall-released fish were captured between 3/22 (day of trap installation) until mid-June and the first spring released fish was not captured until 4/20 (**Figure 29**). In Mill Creek, distributions in 2007 were similar between groups with the exception of a pulse of spring-released fish migrating at the end of the migration window (**Figure 29**).

Table 14. Smolt abundance and overwinter apparent survival estimates for coho juveniles released from 2004, 2005, and 2006.

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)

[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. Estimates in 2006 are likely biased low because abundance estimates were likely biased low (see footnote 4).

[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.

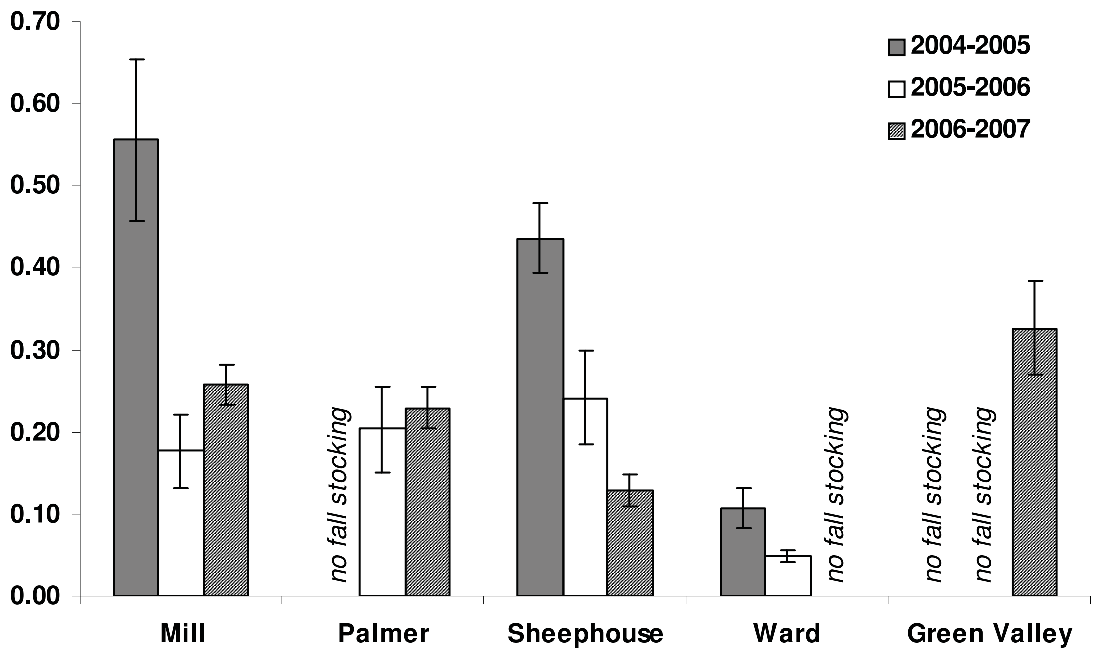


Figure 28. Overwinter apparent survival estimates for fall released juvenile coho during the winters of 2004-2005 through 2006-2007.

Table 15. Estimated number and proportions of spring and fall stocked coho in the fall prior to smolt migration and during smolt migration for fish released in 2005 and 2006.

Release Year	Tributary	Spring and fall abundance and proportions in fall prior to smolt migration			Spring and fall counts and proportions captured in smolt traps [2]		
		# spring (95% CI)	*# fall*	*s:f*	*# spring*	*# fall*	*s:f*
2005	Palmer	1,022 (683-1,433)	1,920	0.53 (0.36-0.75)	67	193	0.35
2005	Sheephouse	3,277 (2,548-4,063)	1,070	3.06 (2.38-3.80)	14	123	0.11
2005	Gray	1,683 (1,209-2,187)	2,240	0.75 (0.54-0.98)	13	38	0.34
2006	Mill	422 (177-730) [1]	6,302	0.07 (0.03-0.12) [1]	319	1,183	0.27
2006	Palmer	1,004 (619-1,424)	3,021	0.33 (0.20-0.47)	156	504	0.31
2006	Sheephouse	1,992 (1,350-2,694)	978	2.04 (1.38-2.75)	58	65	0.89
2006	Gray	1,144 (912-1,382)	3,772	0.30 (0.24-0.37)	53	123	0.43

[1] We suspect that the abundance estimate for 2006 spring released coho in Mill was biased low, therefore the s:f proportion in the fall is likely biased low as well.

[2] Spring trap capture data for Gray Creek was collected by the Austin Creek Project (Katz et. al. 2006, Katz et. al. 2007).

Table 16. Estimated smolt abundance and overwinter apparent survival of spring and fall stocked coho, spring 2006.

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)

[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.

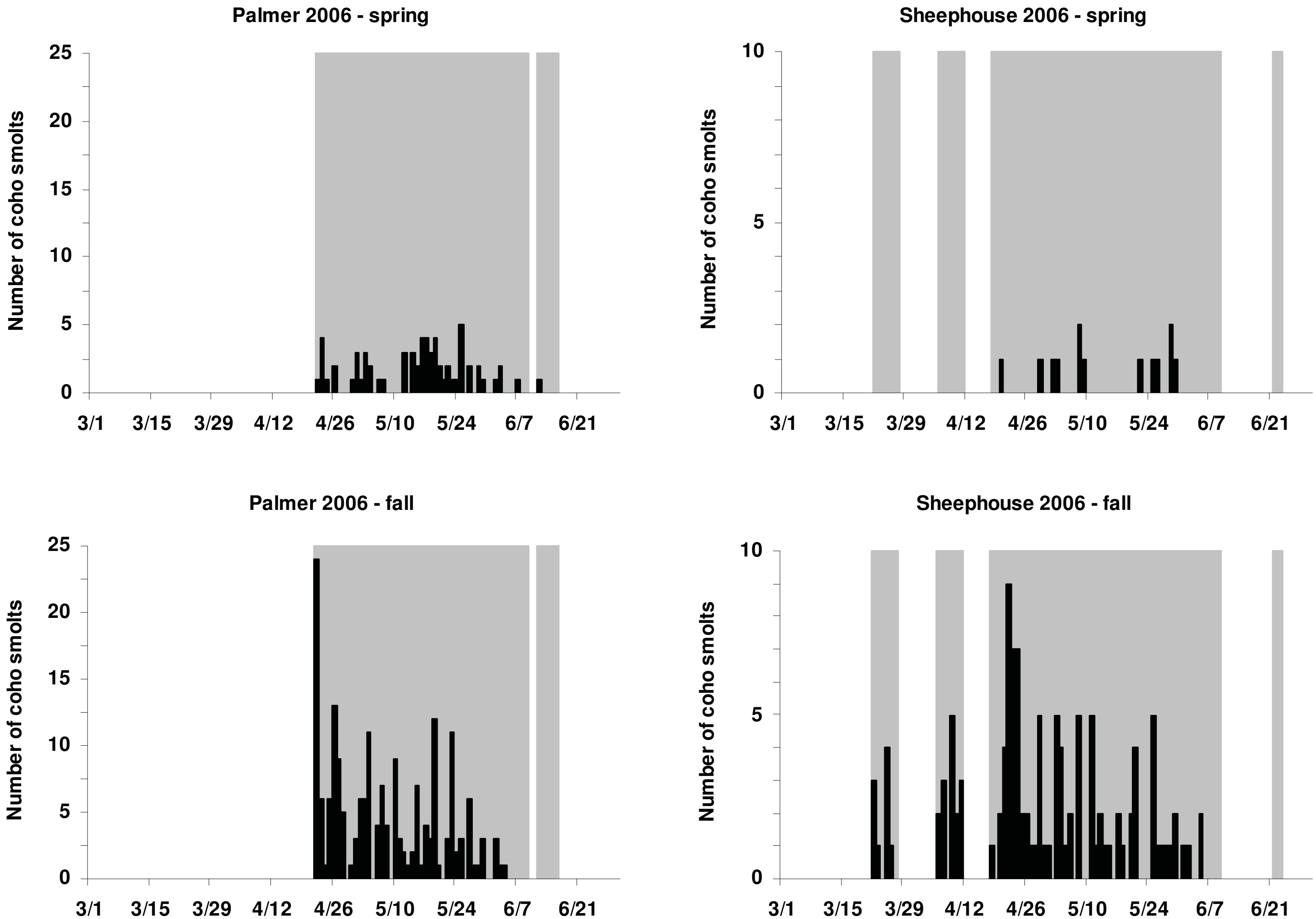


Figure 29. Number of spring and fall released coho stocked into tributaries of the Russian River and captured in downstream migrant traps each day during springs 2006 and 2007. Shaded background indicates days that the traps were in operation. Note different scales on y-axis.

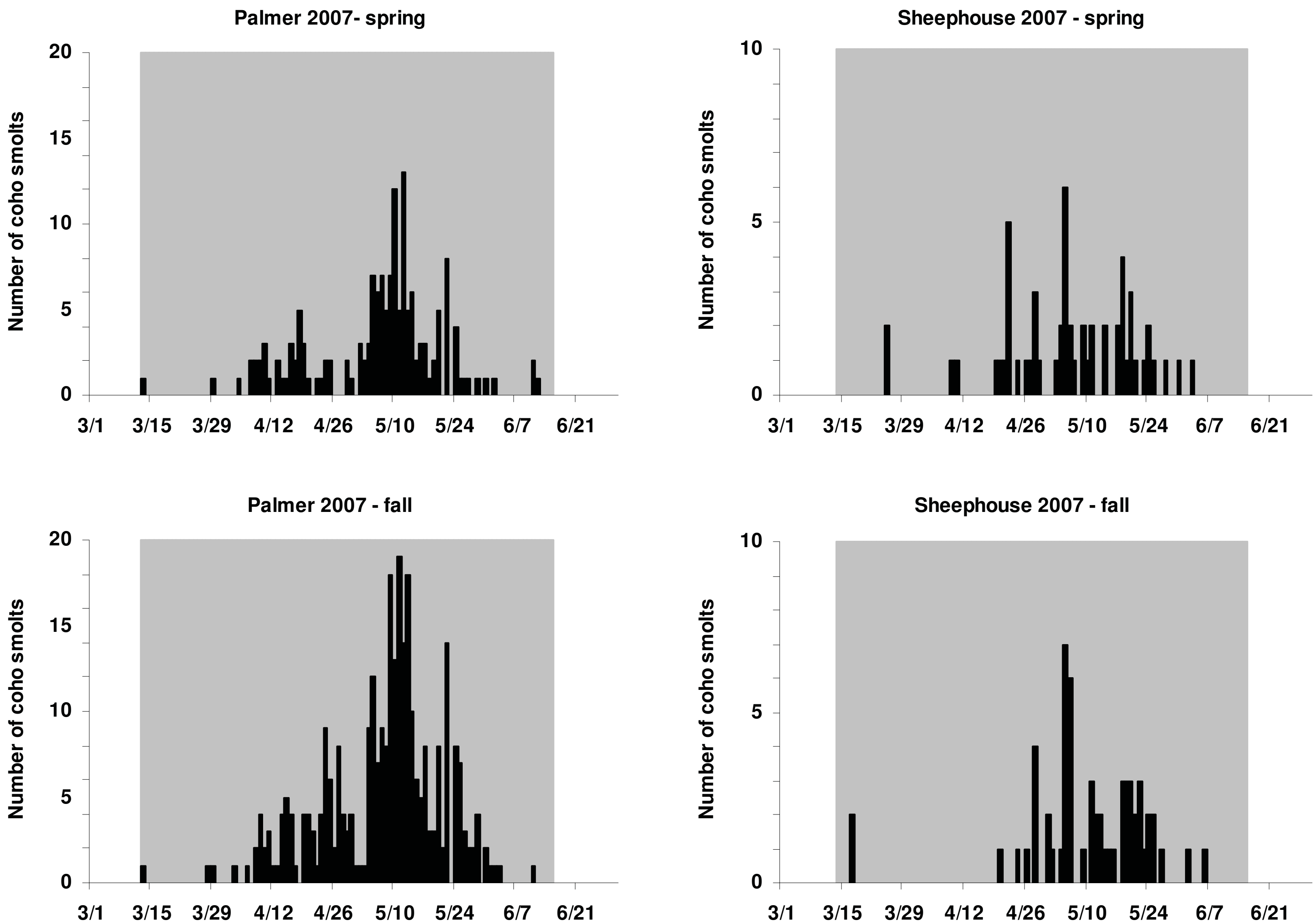
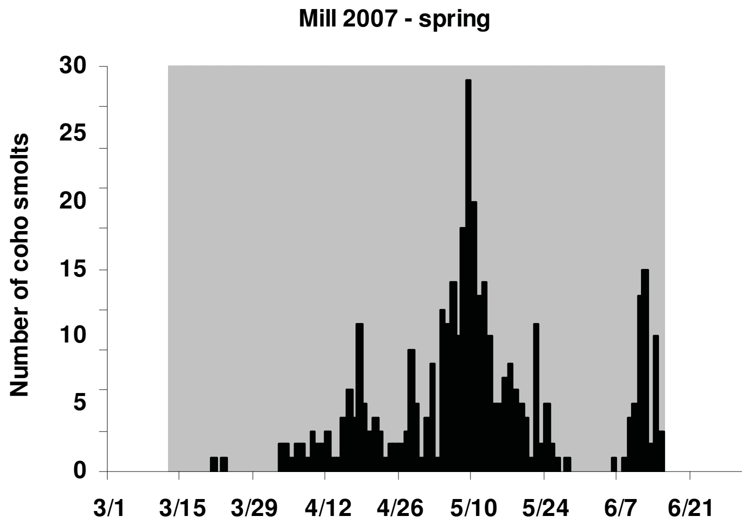


Figure 29 (cont). Number of spring and fall released coho stocked into tributaries of the Russian River and captured in downstream migrant traps each day during springs 2006 and 2007. Shaded background indicates days that the traps were in operation. Note different scales on y-axis.



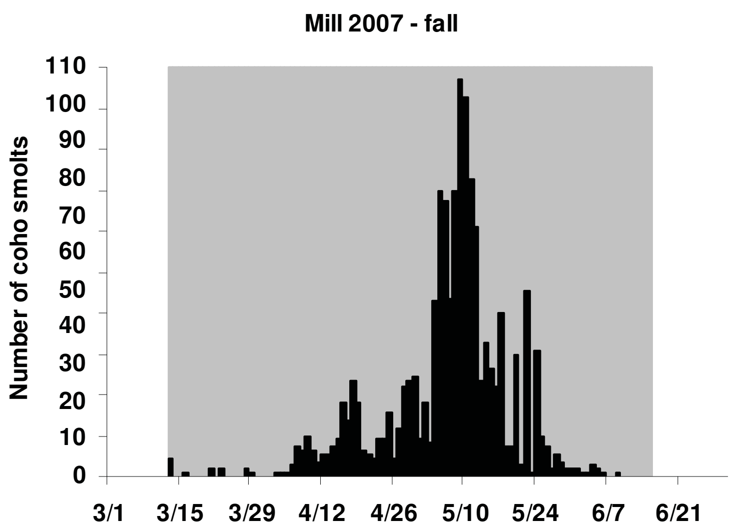


Figure 29 (cont). Number of spring and fall released coho stocked into tributaries of the Russian River and captured in downstream migrant traps each day during springs 2006 and 2007. Shaded background indicates days that the traps were in operation. Note different scales on y-axis

Growth and condition

Among streams, average fork length and weight of smolts captured in Green Valley was higher than in Mill, Palmer, Sheephouse, and Ward. Condition factor was similar among streams (**Figure 30, Table 17**). Average smolt sizes in 2007 were less than average sizes in 2006 (**Table 17**). This is likely a reflection of reduced size at stocking rather than reduced growth rates. Unlike in 2006, where fall-released fish were larger than spring released fish, in 2007 spring and fall release groups were similar in size both at the smolt stage and in the fall prior to smolting (**Table 17**). This was likely due to an effort by Warm Springs Hatchery to closely match the sizes of release groups based on 2006 oversummer growth data. Reduction in the size difference between spring and fall release groups in 2007 may account for the reduction in variation in estimated overwinter apparent survival between groups. In 2007, mean sizes of Mill, Palmer, Sheephouse, and Ward smolts were comparable to sizes observed for wild fish in Olema, Redwood, Pine Gulch, and Upper Lagunitas Creeks, and mean sizes of Green Valley smolts were comparable to values observed in San Geronimo and Lower Lagunitas Creeks (Reichmuth, et. al. 2006).

Genetics samples

Genetics samples were collected on 1,344 program coho smolts, three wild coho smolts (one each from Mill, Sheephouse, and Green Valley Creeks), two wild coho yoy (of Mill Creek system origin, taken to Warm Springs Hatchery for future broodstock) and 273 wild steelhead (269 smolts and four yoy/parr). 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.

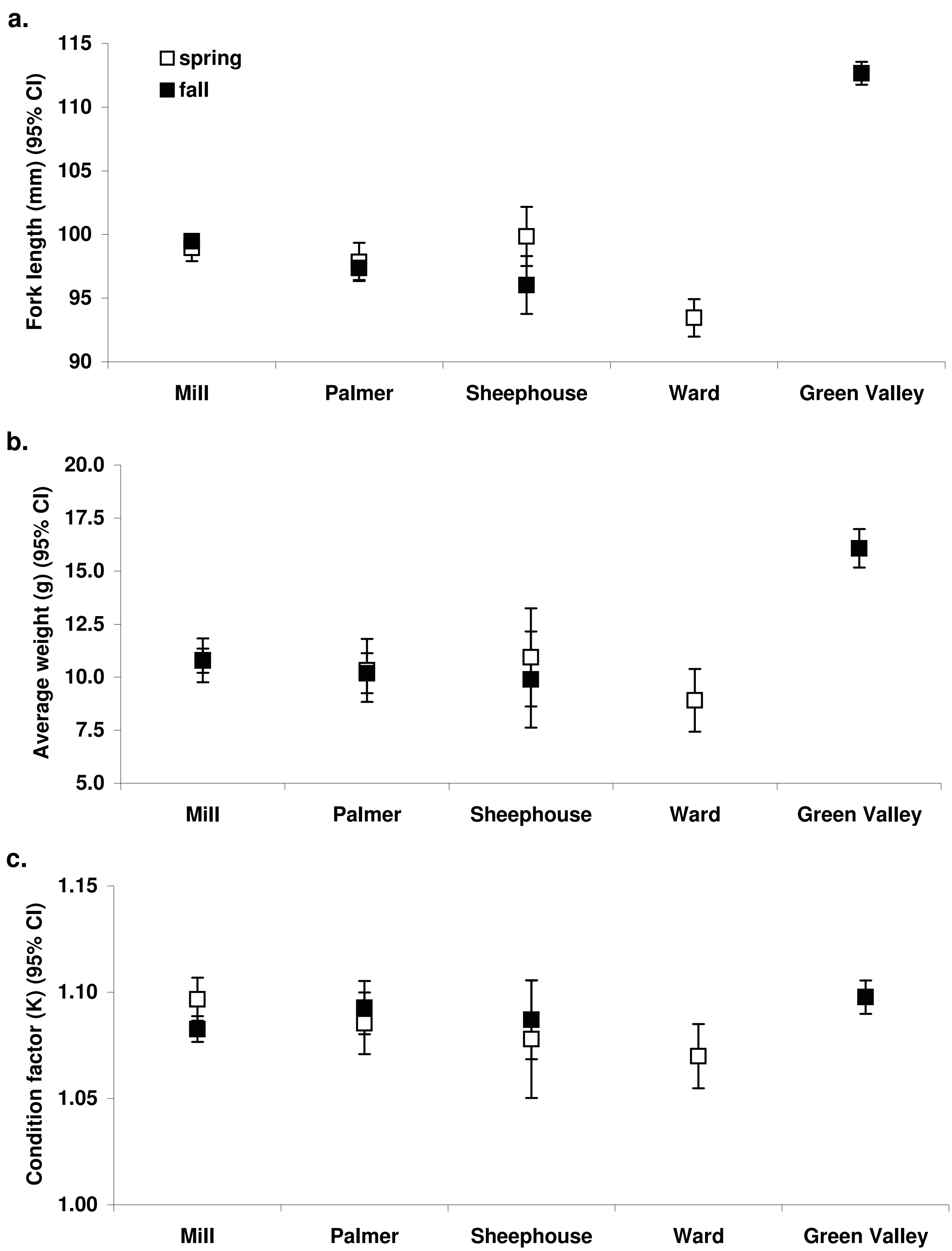


Figure 30. Mean fork length (a), weight (b), and condition factor (c) of coho smolts released in spring or fall 2006 and captured in downstream migrant traps, spring 2007.

Table 17. 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	Size in fall (95% CI)						Size in spring (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	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	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	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	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	-	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	-	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	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	-	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	-	75.5	5.16	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	-	66.8	3.29	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	-	71.2	3.93	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	-	72.9	4.09	0	*NA*	*NA*	119	93.5 (+/-1.5)	8.9 (+/-0.4)	0	*NA*	*NA*
2007	Gray	-	68.0	3.23	100	72.5 (+/-1.0)	4.4 (+/-0.2)	0	*NA*	*NA*	0	*NA*	*NA*
2007	Green Valley	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	1	*NA*	*NA*	150	74.5 (+/-1.0)	5.1 (0.2)	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 18 through 20**).

Table 18. Non-salmonid fish species captured in downstream migrant traps in 2005, 2006, and 2007.

		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	black crappie	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	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	0
2005	Ward	6	0	1	0	59	4	866	4	0	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	2	627	15	0	40	1	0	0	11
2006	Mill	13	61	10	27	65	38	4,066	0	0	3	0	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	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	0
2007	Mill	28	222	9	12	84	38	414	0	0	7	0	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	0
2007	Ward	4	0	2	1	47	13	1,051	10	0	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	0	68	14	20	4	0	3	0	14

[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 19. Amphibian species captured in downstream migrant traps in 2005, 2006, and 2007.

		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

[1] Non-aquatic amphibian.

Table 20. Non-fish and non-amphibian species captured in downstream migrant traps in 2005, 2006, and 2007.

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]
2005	Mill	0	4	11	0	0	1	1	0	0
2005	Sheephouse	0	0	0	0	0	0	0	0	0
2005	Ward	0	0	0	0	0	0	22	2	0
2005	Green Valley	8	0	3	0	1	1	60	0	2
2006	Mill	0	5	7	0	0	0	36	0	0
2006	Sheephouse	0	0	0	0	0	0	4	0	0
2006	Ward	0	11	0	0	0	0	50	0	0
2007	Mill	0	0	0	0	0	0	17	0	1
2007	Sheephouse	0	0	0	0	0	0	7	0	0
2007	Ward	0	0	0	0	0	0	36	0	0
2007	Green Valley	0	0	0	3	1	0	173	0	4

[1] Formerly known as the Western Pond Turtle.

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 21**). Green Valley Creek, which had slightly higher debris loads, had the majority of coho smolt mortalities in 2007. Early in the season this was due primarily to high flows coupled with high debris loads. We also observed that on a couple of occasions, where mortalities occurred in the Green Valley Creek trap, a small proportion of the coho smolts exhibited symptoms including fungus, frayed fins and scale loss. Some of these symptoms may have been due to increasing temperature, predation or interrupted migration from the downstream migrant trapping. Based upon these observations, trapping in Green Valley Creek was halted.

Table 21. Percentage and number of salmonid mortalities observed during operation of downstream migrant trapping, 2005, 2006, and 2007.

Year	Tributary	Coho		Steelhead			Chinook
		yoy	smolt	yoy/parr	smolt	adult	yoy
2005	Mill	25% (6/24)	0.9% (6/634)	0.1% (1/1,904)	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% (1/1,723)	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% (5/2,963)	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)

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

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 31 through 36**). 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 functioning properly. At the downstream temperature (and flow) 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 in 2007 between 6/15 and 10/15 were higher than 2005 averages and lower than 2006 averages with some variability among streams (**Table 22**). 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 37**).

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 order to compare oversummer temperature among spring-release streams, a temperature monitoring site within the stocking reach was chosen for each stream (**Figure 38**). 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 22**, **Figure 38**). 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.

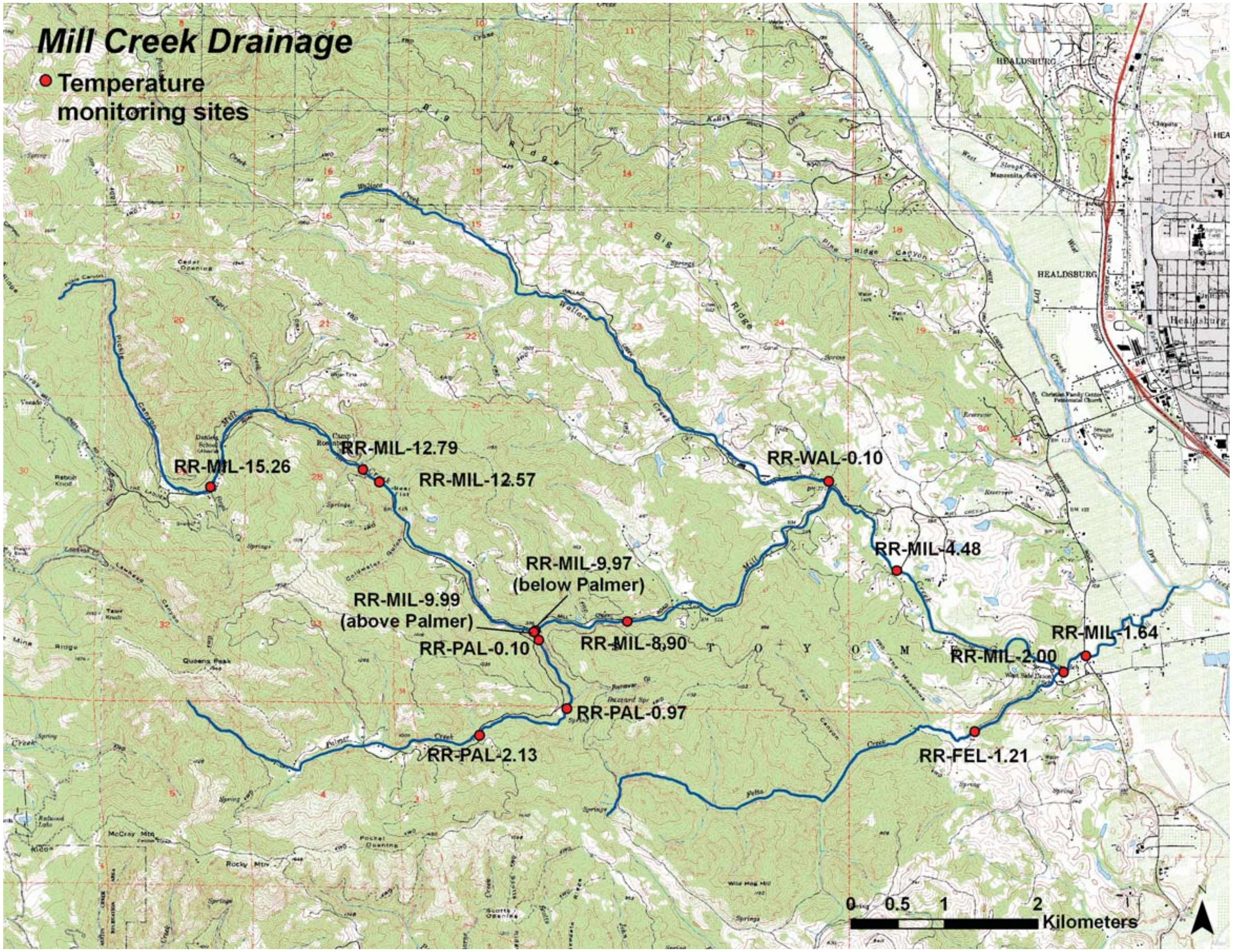


Figure 31. Temperature monitoring sites on Mill, Felta, Wallace, and Palmer Creeks, 2005, 2006, and 2007.

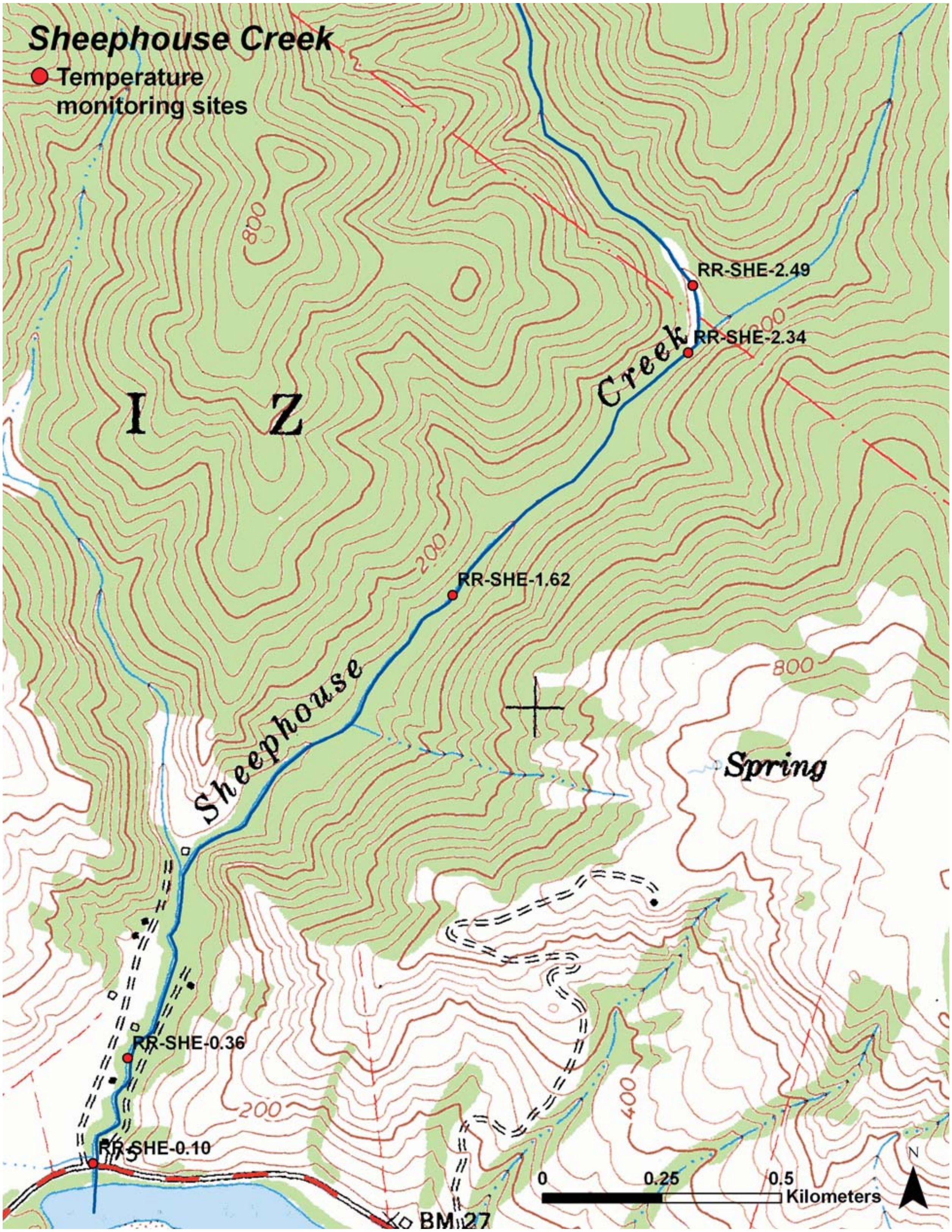


Figure 32. Temperature monitoring sites on Sheephouse Creek, 2005, 2006, and 2007.

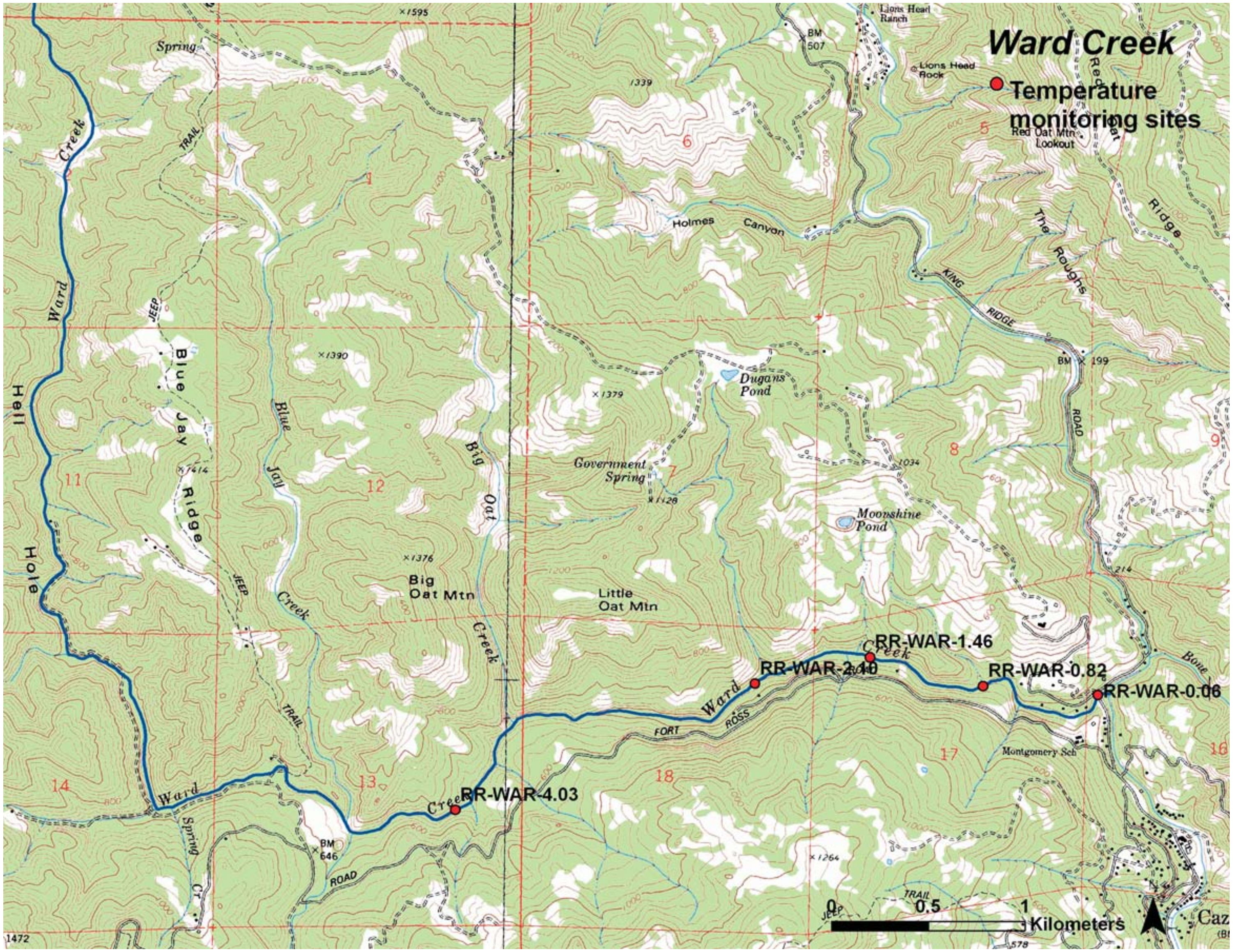


Figure 33. Temperature monitoring sites on Ward Creek, 2005, 2006, and 2007.

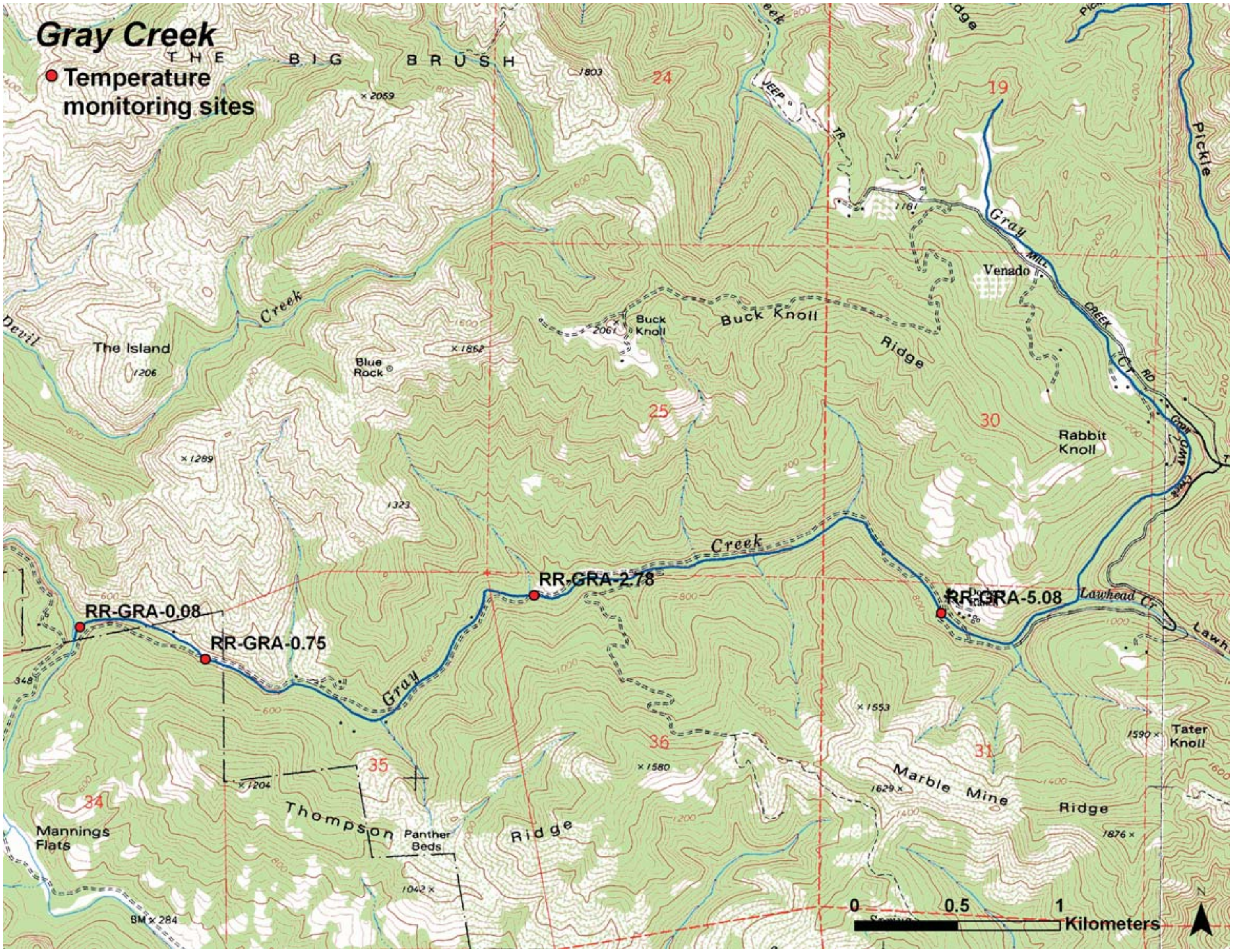


Figure 34. Temperature monitoring sites on Gray Creek, 2005, 2006, and 2007.

Figure 35. Temperature monitoring sites on Green Valley Creek, 2005, 2006, and 2007.

Figure 36. Temperature monitoring sites on Dutch Bill Creek, 2005, 2006, and 2007.

Table 22. 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**
2005	Mill	RR-MIL-9.99	6/22/05	10/15/05		14.88	10.20	20.50	17.85	20.11
2005	Mill	RR-MIL-12.79	6/22/05	10/15/05		14.84	10.70	19.37	17.42	19.05
2005	Mill	RR-MIL-15.26	6/22/05	8/5/05	no data after 8/5	15.98	12.10	18.60	17.27	18.43
2005	Palmer	RR-PAL-0.10	6/22/05	10/15/05		14.75	10.18	19.32	17.74	18.94
2005	Palmer	RR-PAL-0.97	6/22/05	10/15/05		14.79	10.14	19.30	17.71	18.90
2005	Palmer	RR-PAL-2.13	6/22/05	10/15/05		14.57	10.41	18.73	17.17	18.38
2005	Sheephouse	RR-SHE-0.10	6/22/05	10/15/05		13.54	11.18	16.94	14.52	15.91
2005	Sheephouse	RR-SHE-1.62	6/22/05	10/15/05		12.50	9.31	14.89	13.92	14.38
2005	Sheephouse	RR-SHE-2.49	6/22/05	10/15/05		12.28	9.42	15.23	13.76	14.47
2005	Ward	RR-WAR-0.06	6/22/05	10/8/05		17.19	11.82	21.94	20.23	21.75
2005	Ward	RR-WAR-4.03	6/22/05	10/15/05		14.93	10.07	19.34	17.52	19.04
2005	Gray	RR-GRA-2.78	6/28/05	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	6/28/05	10/15/05		14.98	10.99	19.42	17.51	19.04
2005	GreenValley	RR-GRE-2.14	6/22/05	10/15/05		16.42	11.70	20.50	19.29	20.20
2005	GreenValley	RR-GRE-12.49	6/22/05	10/15/05		15.00	10.11	19.80	17.76	19.40
2005	GreenValley	RR-GRE-13.69	6/22/05	8/25/05		16.41	13.22	19.58	18.10	19.13
2005	GreenValley	RR-GRE-13.88	6/22/05	10/15/05		15.22	11.70	19.40	17.67	18.94
2005	Dutch Bill	RR-DUT-10.55	6/22/05	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	6/22/06	10/15/06		15.42	10.34	22.10	20.10	21.37
2006	Palmer	RR-PAL-2.13	6/22/06	10/15/06		15.08	10.28	21.52	19.49	20.80
2006	Wallace	RR-WAL-0.10	6/22/06	10/15/06		15.30	11.32	20.17	18.27	19.11

Table 22 (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 (℃)				
Year	**Tributary**	**Site**	**Start Date**	**End Date**	**Comments**	**Mean**	**Min**	**Max**	**MWAT**	**MWMT**
2006	Felta	RR-FEL-1.21	6/22/06	10/15/06		15.97	11.78	22.64	20.23	21.48
2006	Sheephouse	RR-SHE-0.36	6/22/06	10/9/06		13.10	10.60	15.32	14.63	15.12
2006	Sheephouse	RR-SHE-2.34	6/22/06	10/15/06		12.73	9.80	16.04	14.91	15.52
2006	Ward	RR-WAR-0.06	6/22/06	10/15/06		16.97	10.57	25.76	21.92	24.44
2006	Ward	RR-WAR-0.82	6/22/06	10/15/06		16.82	11.16	24.16	21.78	23.09
2006	Ward	RR-WAR-1.46	6/22/06	10/15/06		16.76	10.39	25.71	21.83	24.77
2006	Ward	RR-WAR-2.10	6/22/06	10/15/06		16.21	9.92	25.42	21.38	24.26
2006	Ward	RR-WAR-4.03	6/22/06	10/15/06		15.51	10.09	22.65	20.04	21.65
2006	Gray	RR-GRA-0.08	6/22/06	10/15/06		16.32	10.54	24.20	20.94	23.32
2006	Gray	RR-GRA-0.75	6/22/06	10/15/06		15.53	9.82	22.48	20.13	21.66
2006	Gray	RR-GRA-2.78	6/22/06	10/15/06		16.00	11.17	22.66	20.17	21.85
2006	Gray	RR-GRA-5.08	6/22/06	10/15/06		15.50	11.33	22.16	20.00	21.40
2006	GreenValley	RR-GRE-2.14	6/22/06	10/12/06		17.52	5.75	25.93	22.06	24.64
2006	GreenValley	RR-GRE-12.49	6/22/06	10/12/06		16.31	11.49	22.65	20.27	21.87
2006	GreenValley	RR-GRE-13.88	6/22/06	10/12/06		16.39	12.41	22.82	20.31	21.71
2006	Dutch Bill	RR-DUT-2.87	6/22/06	10/10/06		15.86	6.37	22.67	18.38	22.00
2006	Dutch Bill	RR-DUT-6.28	6/22/06	10/10/06		15.60	10.55	22.16	19.66	21.05
2006	Dutch Bill	RR-DUT-10.55	6/22/06	10/10/06		13.99	10.71	18.71	16.67	17.55
2007	Mill	RR-MIL-4.48	6/22/07	9/7/07	PIT reach, dewatered	18.50	14.27	24.52	19.89	23.56
2007	Mill	RR-MIL-8.90	7/2/07	10/15/07	PIT reach	15.83	10.08	21.00	18.51	19.81
2007	Mill	RR-MIL-9.97	6/22/07	10/15/07		15.53	9.29	21.79	18.16	20.43
2007	Mill	RR-MIL-12.57	7/2/07	10/15/07	PIT reach	14.95	10.11	18.24	16.95	17.53
2007	Mill	RR-MIL-12.79	6/22/07	10/15/07		15.40	9.46	20.34	17.57	19.09
2007	Palmer	RR-PAL-0.10	6/22/07	10/15/07		14.74	9.50	18.59	16.71	17.51
2007	Palmer	RR-PAL-2.13	6/22/07	10/15/07		15.13	9.31	20.01	17.33	18.80
2007	Wallace	RR-WAL-0.10	6/22/07	10/15/07		14.75	9.92	17.42	16.42	16.85

Table 22 (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	6/22/07	10/15/07		15.28	7.76	20.17	17.30	19.63
2007	Sheephouse	RR-SHE-0.36	6/22/07	10/10/07		12.95	5.86	19.42	14.21	16.72
2007	Sheephouse	RR-SHE-2.34	6/22/07	10/15/07		12.59	9.02	15.38	14.20	14.84
2007	Ward	RR-WAR-0.06	6/22/07	10/15/07		16.91	9.31	23.86	19.73	22.21
2007	Ward	RR-WAR-4.03	6/22/07	10/15/07		14.37	9.17	17.77	16.37	16.88
2007	Gray	RR-GRA-0.08	6/22/07	10/15/07		16.72	10.49	22.17	19.16	21.17
2007	Gray	RR-GRA-0.75	6/22/07	10/15/07		14.90	9.21	19.89	17.12	18.11
2007	Gray	RR-GRA-2.78	6/22/07	10/15/07		15.60	10.23	21.33	18.21	20.16
2007	Gray	RR-GRA-5.08	6/22/07	10/15/07		14.79	10.58	17.63	16.74	17.04
2007	Green Valley	RR-GRE-12.49	6/22/07	10/15/07		15.67	7.32	20.03	17.71	19.24
2007	Dutch Bill	RR-DUT-6.28	6/22/07	10/15/07		15.10	9.09	19.64	17.17	18.41
2007	Dutch Bill	RR-DUT-10.55	6/22/07	10/15/07		13.60	9.62	16.01	15.31	15.76

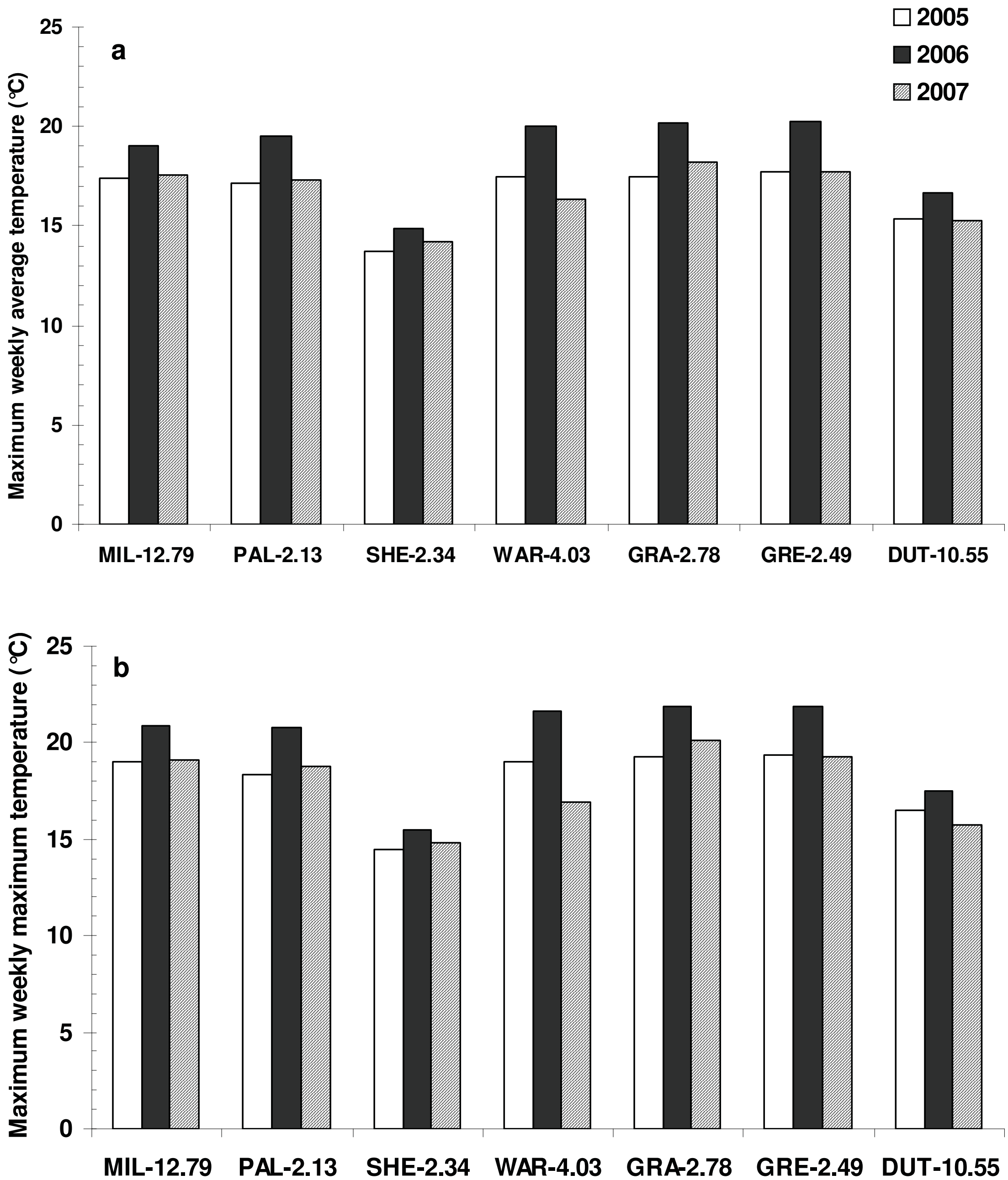


Figure 37. Maximum weekly average temperatures (a) and mean weekly maximum temperatures (b) between 6/15 and 10/15 for stream sites with three consecutive years of data, 2005, 2006, and 2007.

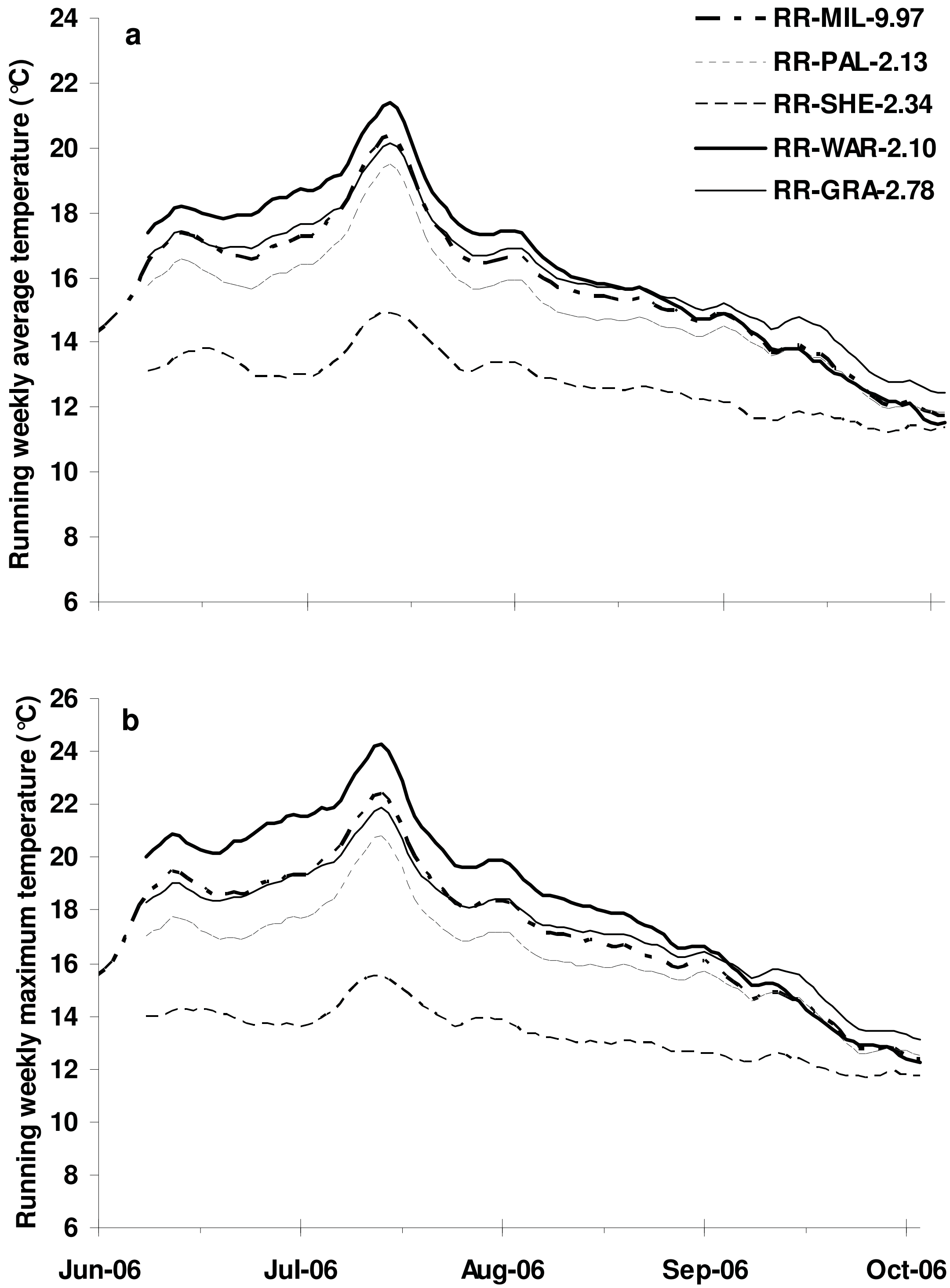


Figure 38. Running weekly average temperature (a) and running weekly maximum temperature (b) for selected monitoring sites on spring stocked program streams between 6/15 and 10/15, 2006. Temperature sites were chosen to represent each stream based on consistency of data and

FLOW COMPARISONS

Flow data was collected on several coho program streams in order to document and compare patterns in 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 spring of 2005. Installation of instrumentation in Green Valley was delayed until fall of 2005 because of a delay in permitting/landowner permission. 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

While the 2006-2007 water year witnessed one extreme storm event on February 10, 2007 (**Figure 39**) it could be characterized as having lower discharge than 2004-2005 or 2005-2006 in the 2005, 2006, and 2007 water years (**Table 23**). This was also demonstrated by the annual hydrographs for Austin and Mill Creeks. Mean daily discharge was greater for an extended time into the summer months during the first two water years than in the last water year. There is some variability by watershed, but in general the lowest minimum daily mean discharge rates occurred in 2006-2007 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.

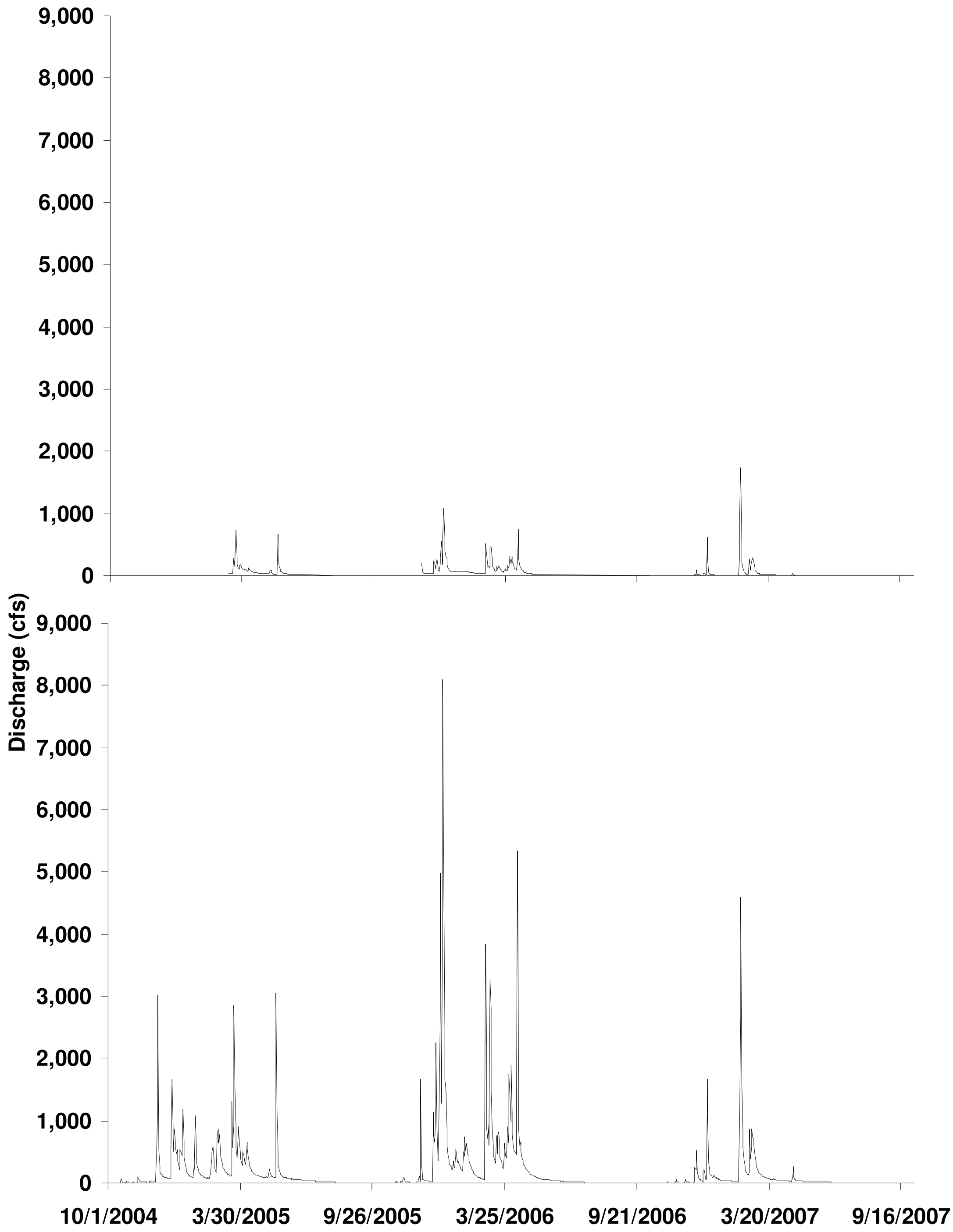


Figure 39. Mean daily discharge for Mill Creek (top) and Austin Creek (bottom) in the 2005, 2006, and 2007 water years.

Table 23. Summary of discharge data collected between October 1 and September 31 at various sites on Russian River tributaries in the 2005, 2006, and 2007 water years.

			Discharge			
Year	Tribuatary	Sampling Days	Min Daily Mean Discharge (cfs)	Max Daily Mean Discharge (cfs)	Annual Mean Discharge (cfs)	Total Annual Discharge (acre-feet)
2005	Dutch Bill	186	1.6	427.3	18.4	10,020
2005	Green Valley	31	N/A	N/A	N/A	N/A
2005	Mill	155	1.0	719.3	51.2	11,545
2005	Sheephouse	221	1.3	206.1	6.7	4,567
2005	Ward	205	2.2	707.3	35.7	19,724
2006	Dutch Bill	192	0.1	1,063.3	88.0	16,195
2006	Green Valley	297	0.6	838.0	18.6	10,895
2006	Mill	235	0.8	1,082.3	82.3	38,202
2006	Sheephouse	317	0.2	395.3	37.5	23,619
2006	Ward	313	0.1	1,602.0	93.3	21,888
2007	Dutch Bill	236	0.0	745.2	78.8	8,606
2007	Green Valley	270	0.0	473.8	37.8	17,000
2007	Mill	226	0.0	1,735.8	31.8	16,994
2007	Sheephouse	230	0.0	161.3	6.1	3,937
2007	Ward	337	1.6	302.0	14.1	9,184

BENTHIC MACROINVERTEBRATE SAMPLING

During the spring and summer of 2006, 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 of 2006. Samples were collected monthly between May and July in lower, middle and upper reaches on each stream. 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

Among streams, averaged over all reaches and months, Green Valley Creek benthic macroinvertebrate samples weighed over twice the amount as any of the other streams and contained over twice the number of invertebrates (**Table 24**, **Figure 40 and 41**). Palmer, Gray and Dutch Bill Creek samples had intermediate levels, while Mill, Sheephouse and Ward were lower. In Mill, Sheephouse and Ward Creeks, benthic macroinvertebrate dry weight data was collected in both 2005 and 2006 (**Table 24**, **Figure 40**). No conclusions can be drawn regarding the overall increased mean weights from 2005 to 2006 because the length of sample collection differed between years. 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 40**).

No clear patterns in invertebrate dry weight or quantity were observed among reaches or months (**Figure 42 through 45**). The lower reach in Green Valley had higher values than in the middle and upper reaches, and the upper reach of Palmer had higher values than in the middle and lower reaches. In most streams invertebrate dry weight and quantity were higher in June and July than they were in May. 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 (**Figure 40 through 43**), but varied by month within streams (**Figure 44 and 45**). For example, in Green Valley samples, dry weights were heaviest in July, whereas the quantity of invertebrates was highest in June. This type of variation likely suggests a change in the type of invertebrates present over the course of the season (e.g. fewer but heavier invertebrates present in July as compared with June).

Table 24. Average dry weight and number of invertebrates of benthic macroinvertebrate samples taken in Russian River tributaries at three transects per reach in May, June, and July, 2005 and 2006.

Year	Tributary	Month	Reach	River km	Mean dry weight (g/m^2) +/- 95% CI	Mean number of invertebrates/m^2 +/- 95% CI
2005	Mill	May	lower	2.02-2.12	0.56 +/- 0.25	*na*
2005	Mill	May	middle	10.00-10.10	1.22 +/- 0.81	*na*
2005	Mill	May	upper	15.21-15.31	0.31 +/- 0.35	*na*
2005	Mill	June	lower	2.02-2.12	0.53 +/- 0.41	*na*
2005	Mill	June	middle	10.00-10.10	0.67 +/- 0.57	*na*
2005	Mill	June	upper	15.21-15.31	0.14 +/- 0.05	*na*
2005	Mill	July	lower	2.02-2.12	0.34 +/- 0.14	*na*
2005	Mill	July	middle	10.00-10.10	0.70 +/- 0.54	*na*
2005	Mill	July	upper	15.21-15.31	0.27 +/- 0.20	*na*
2005	Sheephouse	May	lower	0.72-0.82	0.16 +/- 0.18	*na*
2005	Sheephouse	May	middle	1.84-1.94	0.29 +/- 0.48	*na*
2005	Sheephouse	May	upper	2.41-2.51	0.11 +/- 0.10	*na*
2005	Sheephouse	June	lower	0.72-0.82	0.23 +/- 0.07	*na*
2005	Sheephouse	June	middle	1.84-1.94	0.25 +/- 0.41	*na*
2005	Sheephouse	June	upper	2.41-2.51	0.06 +/- 0.02	*na*
2005	Sheephouse	July	lower	0.72-0.82	0.12 +/- 0.11	*na*
2005	Sheephouse	July	middle	1.84-1.94	0.07 +/- 0.03	*na*
2005	Sheephouse	July	upper	2.41-2.51	0.02 +/- 0.02	*na*
2005	Ward	May	lower	0.10-0.11	0.04 +/- 0.05	*na*
2005	Ward	May	middle	2.03-2.13	0.19 +/- 0.11	*na*
2005	Ward	May	upper	4.06-4.16	0.28 +/- 0.44	*na*
2005	Ward	June	lower	0.10-0.11	0.12 +/- 0.05	*na*
2005	Ward	June	middle	2.03-2.13	0.37 +/- 0.64	*na*
2005	Ward	June	upper	4.06-4.16	0.27 +/- 0.23	*na*
2005	Ward	July	lower	0.10-0.11	0.17 +/- 0.20	*na*
2005	Ward	July	middle	2.03-2.13	0.23 +/- 0.11	*na*
2005	Ward	July	upper	4.06-4.16	0.26 +/- 0.13	*na*

Table 24 (cont). Average dry weight and number of invertebrates of benthic macroinvertebrate samples taken in Russian River tributaries at three transects per reach in May, June, and July, 2005 and 2006.

Year	Tributary	Month	Reach	River km	Mean dry weight (g/m^2) +/- 95% CI	Mean number of invertebrates/m^2 +/- 95% CI
2006	Mill	May	lower	2.02-2.12	0.13 +/- 0.06	361 +/- 94
2006	Mill	May	middle	10.00-10.10	0.08 +/- 0.12	156 +/- 100
2006	Mill	May	upper	15.21-15.31	0.10 +/- 0.07	460 +/- 238
2006	Mill	June	lower	2.02-2.12	0.47 +/- 0.20	2,544 +/- 1,341
2006	Mill	June	middle	10.00-10.10	0.05 +/- 0.01	699 +/- 132
2006	Mill	June	upper	15.21-15.31	0.19 +/- 0.12	1,744 +/- 1,257
2006	Mill	July	lower	2.02-2.12	0.40 +/- 0.19	2,445 +/- 404
2006	Mill	July	middle	10.00-10.10	0.05 +/- 0.03	738 +/- 556
2006	Mill	July	upper	15.21-15.31	0.34 +/- 0.17	2,870 +/- 979
2006	Palmer	May	lower	0.23-0.33	0.18 +/- 0.20	347 +/- 141
2006	Palmer	May	middle	1.98-2.08	0.08 +/- 0.06	342 +/- 141
2006	Palmer	May	upper	3.52-3.62	0.37 +/- 0.26	611 +/- 115
2006	Palmer	June	lower	0.23-0.33	0.32 +/- 0.25	975 +/- 312
2006	Palmer	June	middle	1.98-2.08	0.28 +/- 0.22	1,938 +/- 1,461
2006	Palmer	June	upper	3.52-3.62	1.37 +/- 0.43	5,237 +/- 1,266
2006	Palmer	July	lower	0.23-0.33	0.10 +/- 0.12	1,102 +/- 899
2006	Palmer	July	middle	1.98-2.08	0.14 +/- 0.11	1,235 +/- 995
2006	Palmer	July	upper	3.52-3.62	0.61 +/- 0.16	3,109 +/- 665
2006	Sheephouse	May	lower	0.72-0.82	0.01 +/- 0.01	100 +/- 47
2006	Sheephouse	May	middle	1.84-1.94	0.04 +/- 0.05	138 +/- 82
2006	Sheephouse	May	upper	2.41-2.51	0.01 +/- 0.01	100 +/- 46
2006	Sheephouse	June	lower	0.72-0.82	0.06 +/- 0.02	632 +/- 298
2006	Sheephouse	June	middle	1.84-1.94	0.06 +/- 0.05	654 +/- 407
2006	Sheephouse	June	upper	2.41-2.51	0.02 +/- 0.02	185 +/- 148
2006	Sheephouse	July	lower	0.72-0.82	0.29 +/- 0.13	2,658 +/- 1,237
2006	Sheephouse	July	middle	1.84-1.94	0.09 +/- 0.06	1,470 +/- 856
2006	Sheephouse	July	upper	2.41-2.51	0.04 +/- 0.03	694 +/- 193

Table 24 (cont). Average dry weight and number of invertebrates of benthic macroinvertebrate samples taken in Russian River tributaries at three transects per reach in May, June, and July, 2005 and 2006.

Year	Tributary	Month	Reach	River km	Mean dry weight (g/m^2) +/- 95% CI	Mean number of invertebrates/m^2 +/- 95% CI
2006	Ward	May	lower	0.10-0.11	0.03 +/- 0.02	148 +/- 118
2006	Ward	May	middle	2.03-2.13	0.06 +/- 0.03	221 +/- 125
2006	Ward	May	upper	4.06-4.16	0.20 +/- 0.29	304 +/- 228
2006	Ward	June	lower	0.10-0.11	0.05 +/- 0.06	341 +/- 412
2006	Ward	June	middle	2.03-2.13	0.06 +/- 0.06	122 +/- 97
2006	Ward	June	upper	4.06-4.16	0.22 +/- 0.24	860 +/- 535
2006	Ward	July	lower	0.10-0.11	0.21 +/- 0.06	1,848 +/- 864
2006	Ward	July	middle	2.03-2.13	0.25 +/- 0.13	2,315 +/- 1,195
2006	Ward	July	upper	4.06-4.16	0.29 +/- 0.10	2,012 +/- 736
2006	Gray	May	lower	0.01-0.11	0.14 +/- 0.06	788 +/- 252
2006	Gray	May	middle	0.74-0.84	0.25 +/- 0.19	502 +/- 144
2006	Gray	May	upper	3.64-3.74	0.25 +/- 0.20	577 +/- 240
2006	Gray	June	lower	0.01-0.11	0.34 +/- 0.29	3,648 +/- 4,603
2006	Gray	June	middle	0.74-0.84	0.28 +/- 0.11	1,259 +/- 944
2006	Gray	June	upper	3.64-3.74	0.43 +/- 0.27	1,370 +/- 192
2006	Gray	July	lower	0.01-0.11	0.70 +/- 1.00	1,345 +/- 927
2006	Gray	July	middle	0.74-0.84	0.45 +/- 0.56	3,157 +/- 3,532
2006	Gray	July	upper	3.64-3.74	0.47 +/- 0.24	2,190 +/- 856
2006	Green Valley	May	lower	1.79-1.89	1.26 +/- 1.18	9,363 +/- 9,356
2006	Green Valley	May	middle	9.26-9.36	0.24 +/- 0.08	1,094 +/- 170
2006	Green Valley	May	upper	13.65-13.75	0.21 +/- 0.03	3,893 +/- 2,220
2006	Green Valley	June	lower	1.79-1.89	2.60 +/- 1.04	33,753 +/- 8,349
2006	Green Valley	June	middle	9.26-9.36	0.59 +/- 0.63	3,182 +/- 2,653
2006	Green Valley	June	upper	13.65-13.75	0.81 +/- 0.34	10,447 +/- 6,027
2006	Green Valley	July	lower	1.79-1.89	3.38 +/- 3.30	16,268 +/- 9,294
2006	Green Valley	July	middle	9.26-9.36	0.73 +/- 0.68	7,812 +/- 9,325
2006	Green Valley	July	upper	13.65-13.75	0.79 +/- 0.66	2,163 +/- 866

Table 24 (cont). Average dry weight and number of invertebrates of benthic macroinvertebrate samples taken in Russian River tributaries at three transects per reach in May, June, and July, 2005 and 2006.

Year	Tributary	Month	Reach	River km	Mean dry weight (g/m^2) +/- 95% CI	Mean number of invertebrates/m^2 +/- 95% CI
2006	Dutch Bill	May	lower	2.86-2.96	0.37 +/- 0.31	1,460 +/- 1,016
2006	Dutch Bill	May	middle	6.74-6.84	0.16 +/- 0.10	987 +/- 611
2006	Dutch Bill	May	upper	8.69-8.79	0.21 +/- 0.23	552 +/- 344
2006	Dutch Bill	June	lower	2.86-2.96	1.18 +/- 0.56	3,870 +/- 1,415
2006	Dutch Bill	June	middle	6.74-6.84	0.48 +/- 0.23	3,169 +/- 3,886
2006	Dutch Bill	June	upper	8.69-8.79	0.24 +/- 0.19	2,054 +/- 1,254
2006	Dutch Bill	July	lower	2.86-2.96	0.45 +/- 0.26	2,956 +/- 164
2006	Dutch Bill	July	middle	6.74-6.84	0.41 +/- 0.33	4,696 +/- 4,739
2006	Dutch Bill	July	upper	8.69-8.79	0.25 +/- 0.23	4,230 +/- 4,296

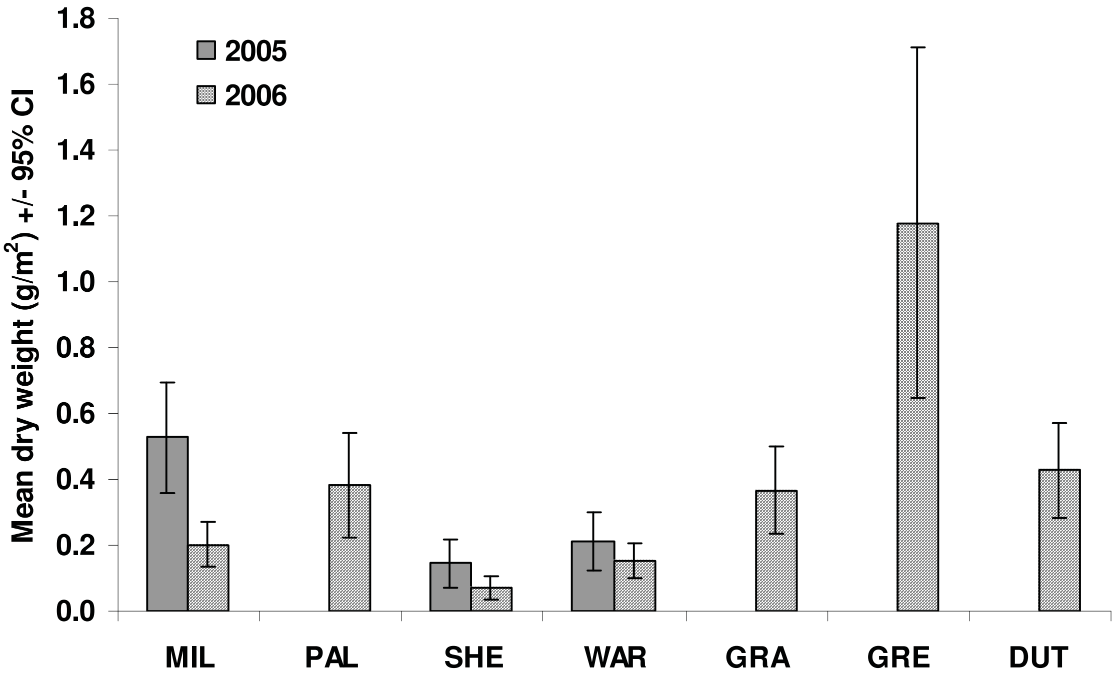


Figure 40. Average dry weight of benthic macroinvertebrate samples collected in multiple reaches of Russian River tributaries in May-July 2005 and 2006.

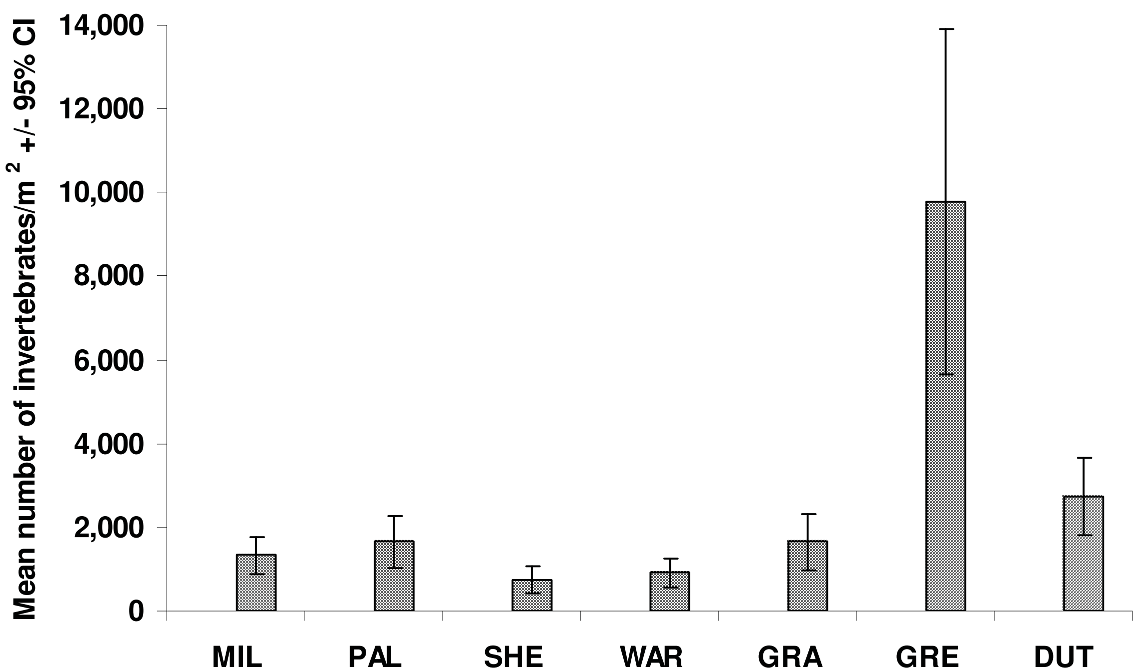


Figure 41. Average number of benthic macroinvertebrate samples collected in multiple reaches of Russian River tributaries in May-July, 2006.

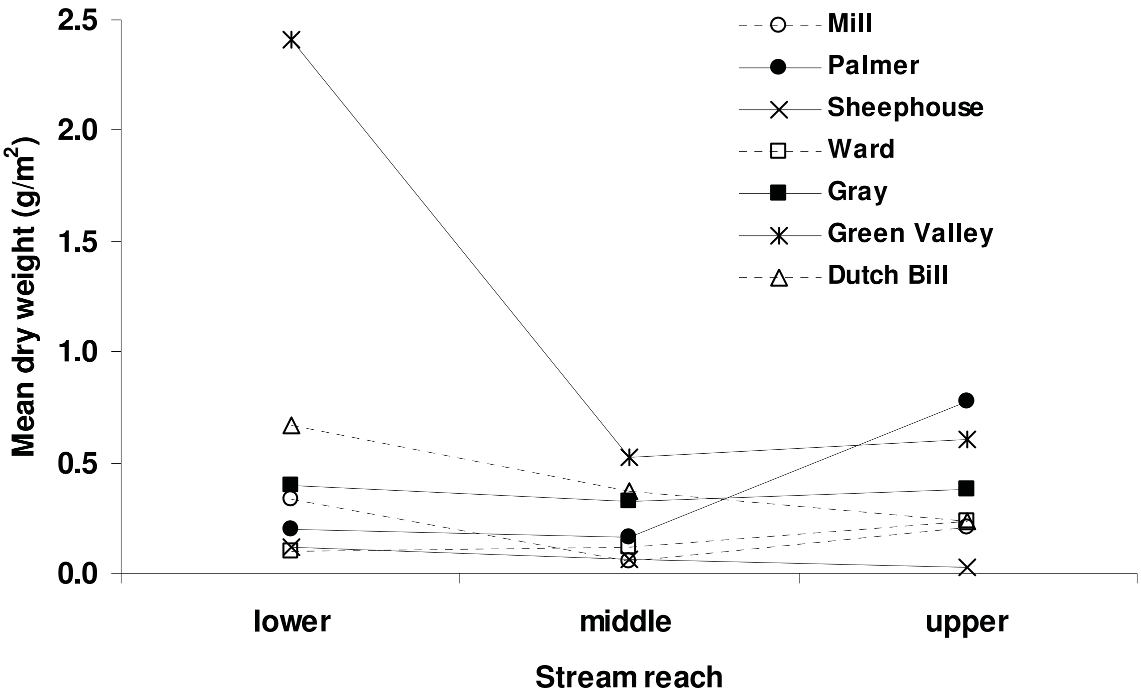


Figure 42. Average dry weight of benthic macroinvertebrate samples taken in lower, middle and upper reaches of Russian River tributaries in 2006.

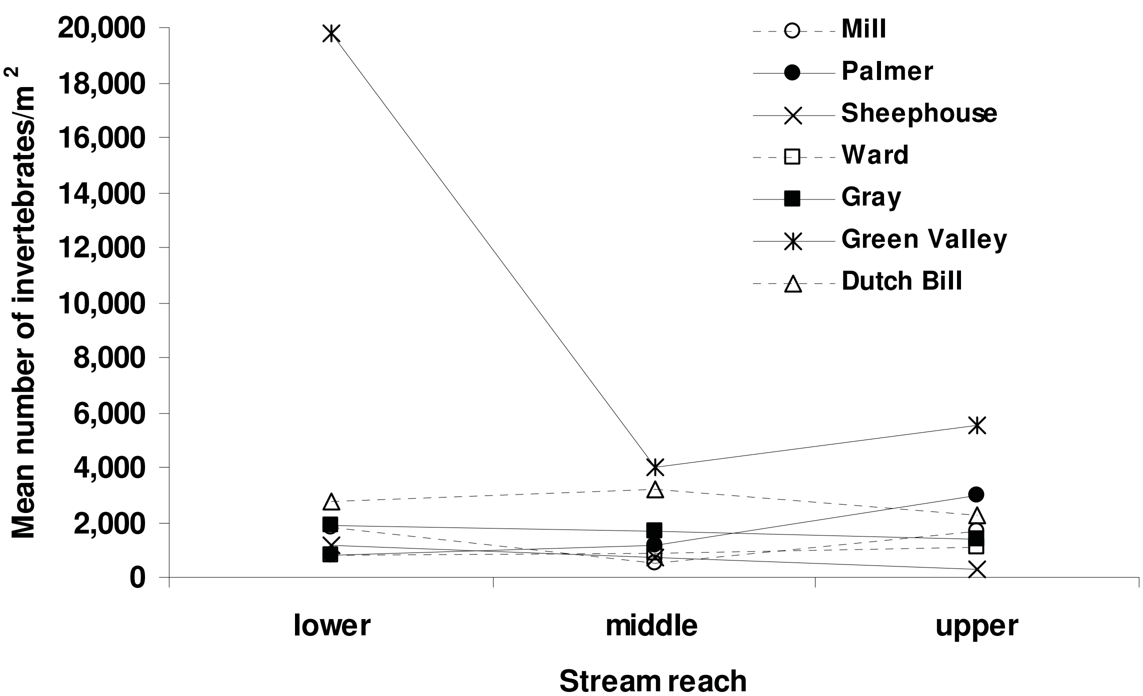


Figure 43. Average number of invertebrates in benthic macroinvertebrate samples taken in lower, middle and upper reaches of Russian River tributaries in 2006.

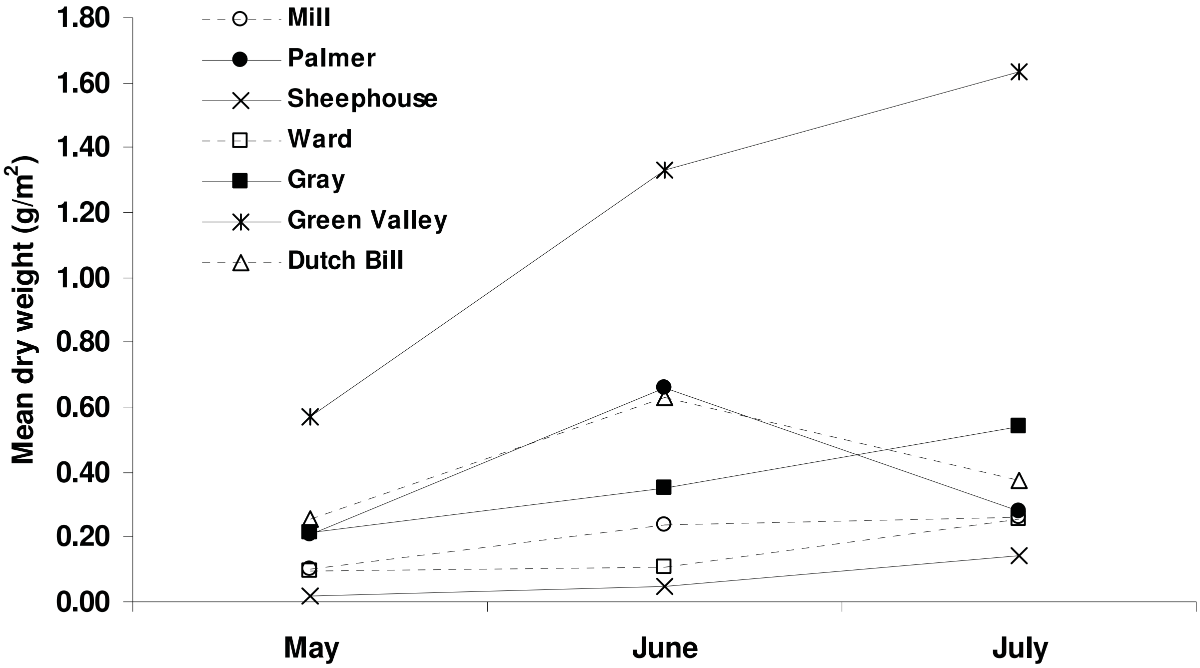


Figure 44. Average dry weight of benthic macroinvertebrate samples taken in Russian River tributaries in May, June and July, 2006.

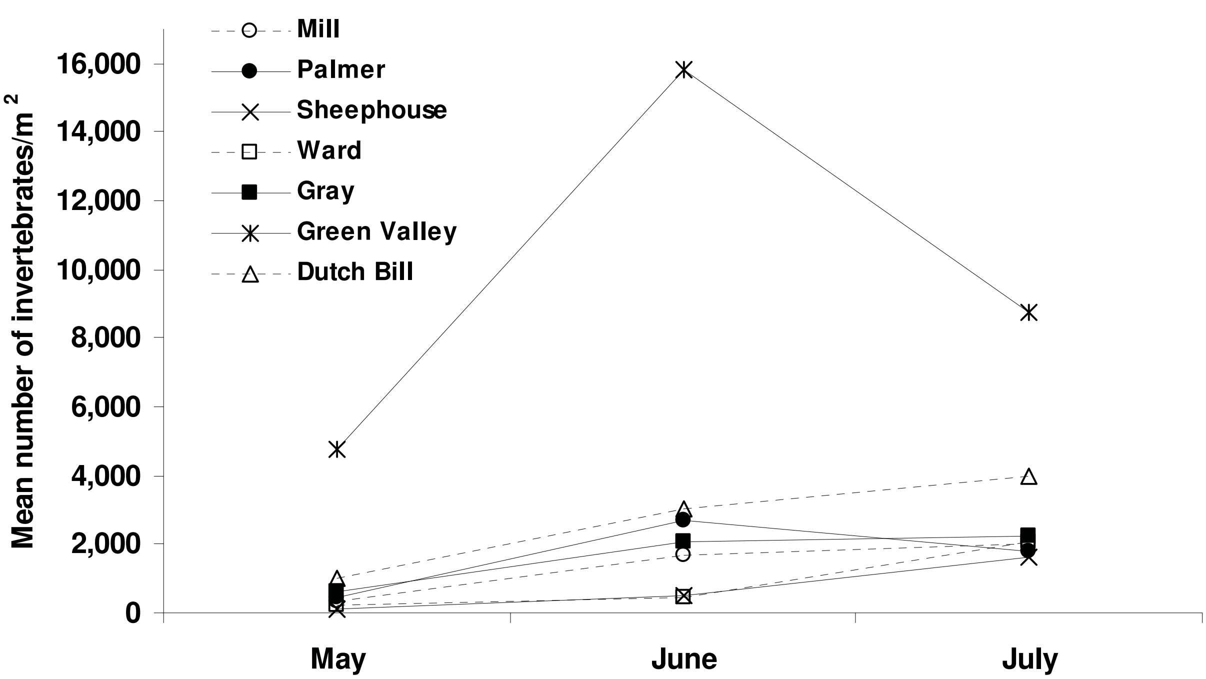


Figure 45. Average number of invertebrates in benthic macroinvertebrate samples taken in Russian River tributaries in May, June and July, 2006.

REFERENCES

Bjorkstedt, E.P. 2000. DARR (Darroch Analysis with Rank-Reduction): A method for analysis of stratified mark-recapture data from small population, with application to estimating abundance of smolts from outmigrant trap data. National Marine Fisheries Service Southwest Fisheries Science Center. Tiburon, CA.

Bjorkstedt, E.P. 2005. DARR 2.0: Updated software for estimating abundance from stratified mark-recapture data. NOAA-TM- NMFS-SWFSC-368. NOAA Fisheries. Santa Cruz, CA.

Brakensiek, K.E. 2002. Abundance and survival rates of juvenile coho salmon (*Oncorhynchus kisutch*) in Prairie Creek, Redwood National Park. Humboldt State University: Masters Thesis. 119 p.

California Department of Fish and Game. 2003. California coastal salmonid restoration monitoring and evaluation program. Interim Restoration effectiveness and validation monitoring protocols. Part III. Validation monitoring of watershed restoration in California pp. 3-14. Sacramento, California.

California Department of Fish and Game. 2006. Stream Inventory Report: Green Valley Creek. Report Revised April 14, 2006; Report Completed 2000; Assessment Completed 1994. California Department of Fish and Game, Hopland, CA. 26p.

Conrad, J. L. 2005. 2001-2004 Annual Report to NOAA Fisheries for the Russian River Coho Salmon Captive Broodstock Program. Geyserville, CA. 17p.

Conrad, L.C., M. Obedzinski, D.J. Lewis, and P.G. Olin. 2006. Annual Report for the Russian River Coho Salmon Captive Broodstock Program: Hatchery Operations and Monitoring Activities. California Department of Fish and Game, Pacific States Marine Fisheries Commission, University of California Cooperative Extension and Sea Grant Program. Santa Rosa, California.

Cook, D. and D. Manning. 2002. Data Report 1999-2001: Russian River Basin Steelhead and Coho Salmon Monitoring Program Pilot Study. Sonoma County Water Agency, Santa Rosa, CA. 60p

Dolloff, C.A., D.G. Hankin, and G.H. Reeves. 1993. Basinwide estimation of habitat and fish populations in streams. General Technical Report SE-083, USDA Forest Service.

Fawcett, M.H., J. C. Roth and D. W. Smith. 2003. Salmonid Juvenile Density Monitoring in Sonoma County Streams, Synthesis of a Ten-Year Study (1993-2002). Prepared by Merritt Smith Consulting, Lafayette, CA, for the City of Santa Rosa, CA. 52p.

Gallagher, S.P. and C.M. Gallagher. 2005. Discrimination of Chinook and coho salmon and steelhead redds and evaluation of the use of redd data for estimating escapement in several unregulated streams in northern California. North American Journal of Fisheries Management 25: 284-300.

Gallagher, S.P., P.K.J. Hahn and D.H. Johnson. 2007. Redd Counts. Pages 197-233 in D.H. Johnson, B.M. Shrier, J.S. O'Neal, J.A. Knutzen, X. Augerot, T.A. O'Neil and T.N. Pearsons. Salmonid Field Protocols Handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, Maryland.

Katz, J., G. Reedy and D. Hines. 2006. Downstream migrant trapping results and steelhead (Oncorhynchus mykiss) smolt abundance estimate for lower Austin Creek, 2006. NOAA Fisheries, Santa Rosa, CA.

Kruzic, L.M., D.L. Scarnecchia, and B.B. Roper. 2001. Comparison of midsummer survival and growth of age-0 hatchery coho salmon held in pools and riffles. Transactions of the American Fisheries Society. 130:147-154.

Mosley, M.P. and McKerchar, A.I. (1993) Streamflow, in *Handbook of Hydrology*, (ed. Maidment, D.R.). McGraw-Hill, Inc. USA.

Obedzinski, M., J.C. Pecharich, G. Vogeazopoulos, D.J. Lewis, and P.G. Olin. 2007. Monitoring the Russian River Coho Salmon Captive Broodstock Program: Annual Report, July 2005-June 2006. University of California Cooperative Extension and Sea Grant Program. Santa Rosa, California.

Reichmuth, M., B.J.Ketcham, K. Leising, and B. Craig. 2006. Olema Creek watershed summary monitoring report, Marin County, CA 1997-2006. National Park Service. San Francisco Area Network. Inventory and Monitoring Program. PORE/NR/WR/06-02

Welsh, H.H., G.R. Hodgson, B.C. Harvey, and M.F. Roche. 2001. Distribution of juvenile coho salmon in relation to water temperatures in tributaries of the Mattole River, California. North American Journal of Fisheries Management 21:464-470.

White, G.C., D.R. Anderson, K.P. Burnham, and D.L. Otis. 1982. Capture-recapture methods for sampling closed populations. Los Alamos National Laboratory, New Mexico.

White, G.C. and K.P. Burnham. 1999. Program MARK:survival estimation from populations of marked animals. Bird Study 46:120-139.

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