

Redwood

National Park

National Park Service
US Department of the Interior



2012 REDWOOD CREEK SUMMER STEELHEAD SURVEY



Fish and Wildlife Branch
September 2015

Cover Photos: (Taken during 2012 survey)
Top Left: Lamprey on redd in Redwood Creek
Top Right: Diver looking at river map
Middle Left: Dead summer steelhead
Bottom Left: Summer steelhead snorkeler
Bottom Right: Panther Creek mouth at confluence with Redwood Creek

2012 RNP REDWOOD CREEK SUMMER STEELHEAD SURVEY

DATES: July 23, 24, 25, 26, 30, 31 (Monday – Thursday, Monday and Tuesday) and August 1 (Wednesday) 2012.

LOCATION: Redwood Creek, Humboldt County, California
Mainstem reach from Lacks Creek - river km 46.514 to downstream of Hayes Creek (Redwood National and State Parks) - river km 7.65.

DISTANCE: 38.9 km (24.1 miles) [36 % of the 108-km (67.1-mile) long Redwood Creek mainstem]

FLOWS: Gaging Station: Orick [ORK] (<http://cdec.water.ca.gov/river/rivcond.html>)
Start of Survey: 105 cfs End of Survey: 82 cfs

DIVERS: David Anderson¹, Terry Hines¹, Kyle Max¹, Joanna DiTommaso, Alder Gustafson, and Rachel McCain² (Divers with prior summer steelhead snorkeling experience on ¹Redwood Creek or ²Smith River). Recorders: Heather Brown and Alder Gustafson.

METHOD: Visual observation by diving with mask and snorkel, and surf wetsuit (Roelofs 1983). Survey proceeded in the downstream direction with the flow.

ACCESS: Lacks Creek via Stover Ranch on Redwood Valley Road; drive and hike to Panther Creek via Green Diamond Resource Company K&K road at Big Lagoon; hike/snorkel and camp on river four days/three nights to reach summer footbridge downstream of Tom McDonald Creek/Tall Trees Grove and trail to 44 horse camp. Drive out C-12/A9-9/West Side Access; Cloquet Creek in or out via A-9 road and hike road extension to Redwood Creek trail; and downstream of Hayes Creek intercept Redwood Creek trail and hike to lower trailhead parking lot.

ITINERARY:	Date	Survey Reaches	Distance	SSHD No.
	8/1	Lacks Creek to Panther Creek		
		<i>Anderson, Max, DiTommaso, and Gustafson.....</i>	6.02	0
	7/23	Panther to Below Devils Cr (33.875 km)		
		<i>Anderson, Max, Hines, and DiTommaso.....</i>	6.62	1
	7/24	Below Devils Cr to Above Pig Pen Prairie (29.75km)		
		<i>Anderson, Max, Hines, and DiTommaso.....</i>	4.12	1
	7/ 25	Above Pig Pen to Bridge Creek		
		<i>Anderson, Max, Hines, and DiTommaso</i>	5.23	5
	7/26	Bridge Creek to Tall Trees Summer Bridge (19.25km)		
		<i>Anderson, Max, Hines, and DiTommaso.....</i>	5.27	1
	7/30	Tall Trees Summer Bridge to Cloquet Cr		
		<i>Anderson, Max, DiTommaso, and McCain</i>	4.05	0
		<i>(Recorder- Gustafson)</i>		
	7/31	Cloquet Creek to Downstream of Hayes Creek		
		<i>Anderson, Max, and Gustafson (Recorder – Brown).....</i>	7.55	0

TOTAL NUMBER OF ADULT SUMMER STEELHEAD OBSERVED IN 2012: 8 (7 live & 1 dead)

Number of Adult Summer Steelhead Trout Observed within the Index Section (Lacks Creek to Tom McDonald Creek - 16.1 miles): 8 (7 live & 1 dead)

SUMMER STEELHEAD

Summer steelhead (*Oncorhynchus mykiss*) are an anadromous race of rainbow trout. Their life cycle differs from that of the more numerous winter-run steelhead. Adult summer steelhead ascend the rivers in spring, hold over in deep pools in the summer, and then spawn in winter. Because adult summer steelhead hold in freshwater 8 - 10 months (Roelofs 1983), they are vulnerable to detrimental environmental and human-caused factors including higher water temperatures, low summer flows, decreasing pool depths, and poaching. Steelhead within the Northern California coastal steelhead ESU (evolutionary significant unit), which includes Redwood Creek, were federally listed by NOAA Fisheries as threatened in June 2000 and relisted in 2006.

Summer 2012 was the 32nd consecutive annual summer steelhead trout survey of Redwood Creek, the first being 1981. The survey reach began at Lacks Creek at Stover Ranch and proceeded 38.9 km downstream through Green Diamond Resource Company timber lands into Redwood National Park to a location downstream of Hayes Creek. Originally, the survey reach was from Lacks Creek to Tom McDonald Creek, but it was expanded downstream to downstream of Hayes Creek in 1992.

Eight (seven live and one dead) adult summer steelhead (steelhead ≥ 16 inches), four ‘half-pounder’ steelhead (smaller immature sea-run steelhead returning after less than one year in the ocean), and 168 coastal cutthroat trout (*O. clarki*) (cutthroat ≥ 10 inches) were observed in the mainstem survey reach (Table 1). All eight summer steelhead were observed within the original index reach, Lacks to Tom McDonald Creeks.

The eight summer steelhead were all observed in pools (Table 2). One of the pools was associated with a westside tributary. Past data from Redwood Creek show the majority of summer steelhead are observed in pools, and pools associated with the inflow of cooler water from tributaries (Anderson 1993). All eight observations were solitary fish. Estimated fish length ranged between 16 and 26 inches. Fish fork lengths were estimated by referring to marked (in inches) leashes that were used by the snorkelers to tow their floating packs.

Six of the eight fish were in the middle reach between G Creek and Copper Creek. One was upstream between Coyote and Devils Creeks, and the other, downstream between Harry Weir (Emerald) and Tom McDonald Creeks (Figure 1).

Steelhead numbers over time are presented in Figure 2 and Appendix I.

Western Pearlshell (*Margaritifera falcata*) freshwater mussels were observed at six mainstem Redwood Creek locations during the 2012 summer steelhead survey of mainstem Redwood Creek (Appendix II). Where noted, they ranged in size from less than one-half inch to ‘larger’ and totaled more than 48 individuals.

Table 1. Numbers of adult summer steelhead ($\geq 16''$), 'half-pounder' steelhead, and coastal cutthroat trout, and aquatic/wildlife observed during the 2012 summer steelhead survey of mainstem Redwood Creek, Humboldt County, California, July 23 through August 1, 2012. (Stream reaches are broken out to reflect the original survey reaches that were based on access points, the majority of which are no longer accessible by vehicle.)

Redwood Creek Mainstem Stream Reach		No. of Summer Steelhead Adults (≥16")	No. of Steelhead Half Pounders	No. of Cutthroat Trout (≥ 10")	Aquatic/Wildlife Observed
ORIGINAL INDEX REACH	Lacks to Panther Creek 8/1/2012	0	0	30	Bear (1), Great Blue Heron, American Dippers, Belted Kingfisher, Garter Snake, Pacific Giant Salamander. Steers running across creek (~12)
	Panther to Coyote Creek 7/23/2012	0	2	12	Steelhead juveniles, Chinook salmon juveniles, Threespine Stickleback, Juga snails, Limniphilid caddisfly nymphs, Bear,(1)Tiger swallowtail butterfly
	Coyote to Copper Creek 7/23 & 24/2012	1	0	13	One adult lamprey on redd at river km 34.64. Total of three redds present (UTM: 421911E/4553443N). Threespine stickleback, Sacramento Suckers, Belted Kingfisher, Marble murrelets heard morning of 7/24/2012 from 5:15 to 6:40 am. Beaver (one juvenile) and beaver lodge in bank. Mayfly and stonefly hatch.
	Copper to Pig Pen Prairie (Slide Cr) 7/24-25/2012	3 (2 live & 1 dead)	0	15	Marbled murrelets (25+) heard on 7/25/2012 from 5:35am to 6:25am.
	Pig Pen Prairie (Slide Cr) to Bridge Creek 7/25/2012	3	2	11	Resident trout (1@14")
	Bridge Creek to Tom McDonald Creek 7/26/2012	1	0	11	Bull elk (4). Marbled murrelets (morning). Campsites: 1, Campers: 2
	Tom McDonald to Bond Creek 7/26, 30/2012	0	0	21	Sacramento suckers (100s), Sculpin, Threespine stickleback, Spotted Sandpipers, Belted Kingfisher, Osprey, Common Merganser, Yellow-legged frogs. Campsites: 3, Campers: 14, Hikers: 2
	Bond Creek to downstream of Hayes Creek 7/30-31/2012	0	0	55	~20 5"-8" Cutthroat, Yellow-legged frogs and tadpoles, Toad tadpoles, Tree frog, Sacramento suckers, Dead adult lamprey, Otter tracks. Osprey, Mallard, American Dipper, Great Blue Heron, Black crowned Night Heron, Common Raven, Belted Kingfisher, Stellars Jay, Spotted Sandpiper, Red shouldered Hawk, Varied Thrush, Turkey Vulture, Cedar Waxwing, Black Phoebe, Bushtit, Red Crossbill, Pacific Wren, Chestnut backed Chickadee, Wilsons Warbler, Swainson Thrush, Song Sparrow, Brown Creeper, Pacific Slope Flycatcher, American Robin. Campsite: 1, Campers: 2 + 1 Dog
Total		8 (7 live & 1 dead)	4	168	

Table 2. Date, location (river kilometer and UTM coordinates [NAD83]), number, estimated fork length (inches), and habitat description of adult summer steelhead trout observed in the 2012 snorkel survey of mainstem Redwood Creek, upstream to downstream. (Letters in parentheses in the river km refer to locations on Figure 1 map).

Date	River KM	No. of SSHD	Est. Length (inches)	Habitat Description
SUMMER STEELHEAD				
7/23/2012	35.75 (a)	1	24"	Fish in 8ft of water alongside of large rock. Pool dimensions: ~200m L x 25m W x 8ft D. Water temperature 19.0°C at 16:50. UN ES 35.7384 tributary entering pool at 14.0°C. (UTM 422561E 4552897N)
7/24/2012	31.23 (b)	1	24"	Queen's Hole. Fish at 15ft depth and 10ft back under rock ledge along woody debris. Water temperature 18.0°C at 12:30. Pool dimensions: 75m L x 20m W x 20ft D. (UTM: 421350E 4556450N)
7/25/2012	29.70 (c)	1	22"	Fish dead in pool. Not dead long, gill filaments were light pink. (UTM: 420820E 4557630N)
7/25/2012	29.45 (d)	1	16"	Upstream of Pig Pen Prairie. Fish in 3ft of water in woody debris. Pool dimensions: 75m L x 20m W x 9ft D. (UTM: 420600E 4557725N)
7/25/2012	28.25 (e)	1	24"	Fish under rock by UN WS 28.243 tributary. Tributary was 13.5°C and Redwood Creek was 18.0°C at 11:04. Pool dimensions: 30m L x 10m W x 8ft D. (UTM: 419980E 4558625N)
7/25/2012	27.75 (f)	1	26"	Fish under boulder ledge in 5 feet deep water back against the substrate. Redwood Creek water temperature 20.0°C at 14:10. Pool dimensions: 50m L x 15m W x 5ft D. (UTM: 419425E 4559400N)
7/25/2012	26.98 (g)	1	24"	Fish under rock shelf in 7 feet deep water. Water temperature 20.0°C at 14:40. Pool dimensions: 150m L x 25m W x 7ft D. (UTM: 419328E 4559620N)
7/26/2012	21.90 (h)	1	22"	Fish was spooked and swam under log at bottom of pool in 5ft of water. Water temperature 22.0°C at 11:25. Pool dimensions: 75m L x 10m W x 8-9ft D. (UTM: 415856E 4561792N)
Summer Steelhead Total		8	(7 live and 1 dead)	

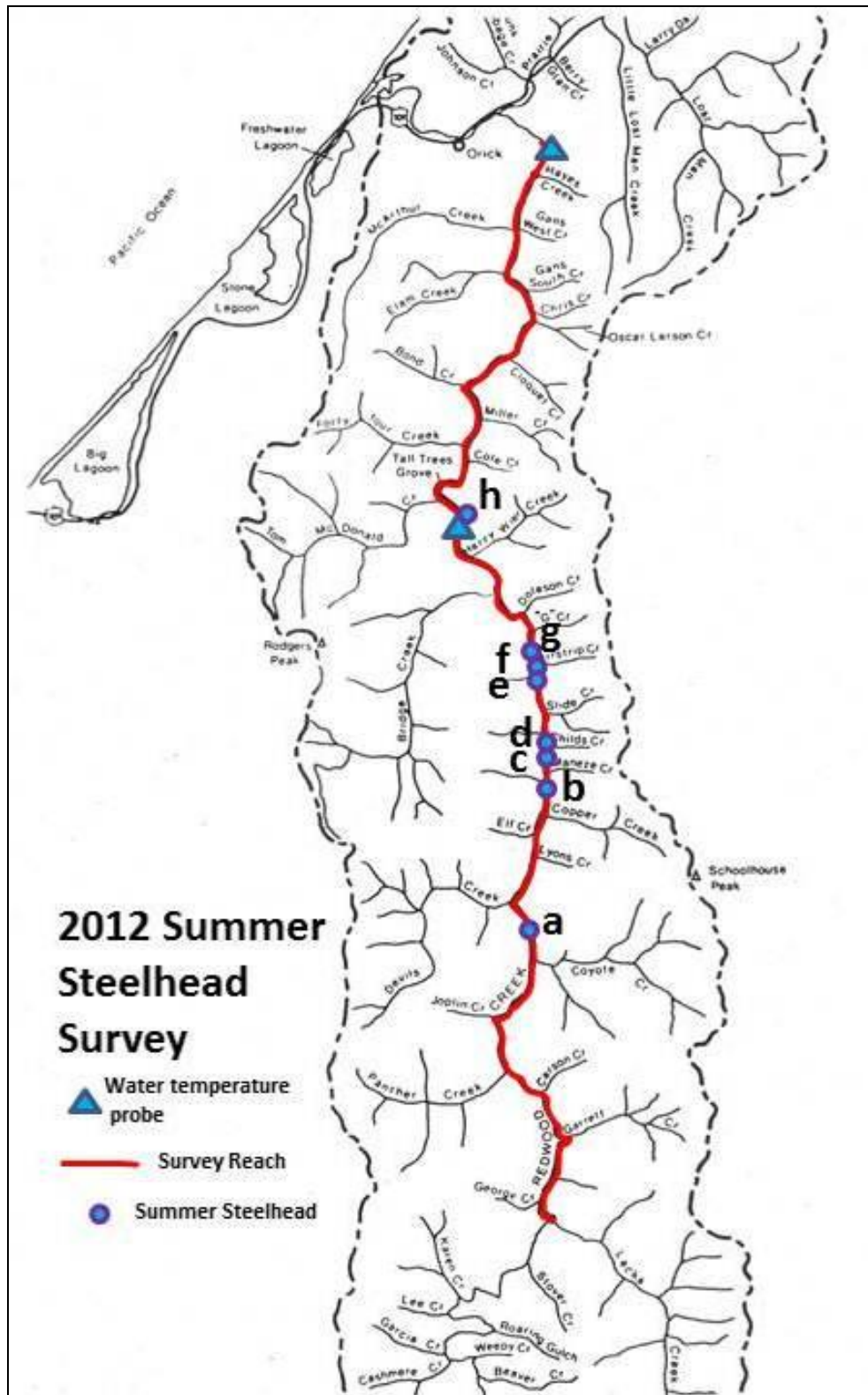


Figure 1. Location of the eight adult summer steelhead observed during the 2012 snorkel survey of Redwood Creek, Humboldt County, California. Survey was between Lacks Creek to downstream of Hayes Creek from July 23 to 31 and August 1, 2012.

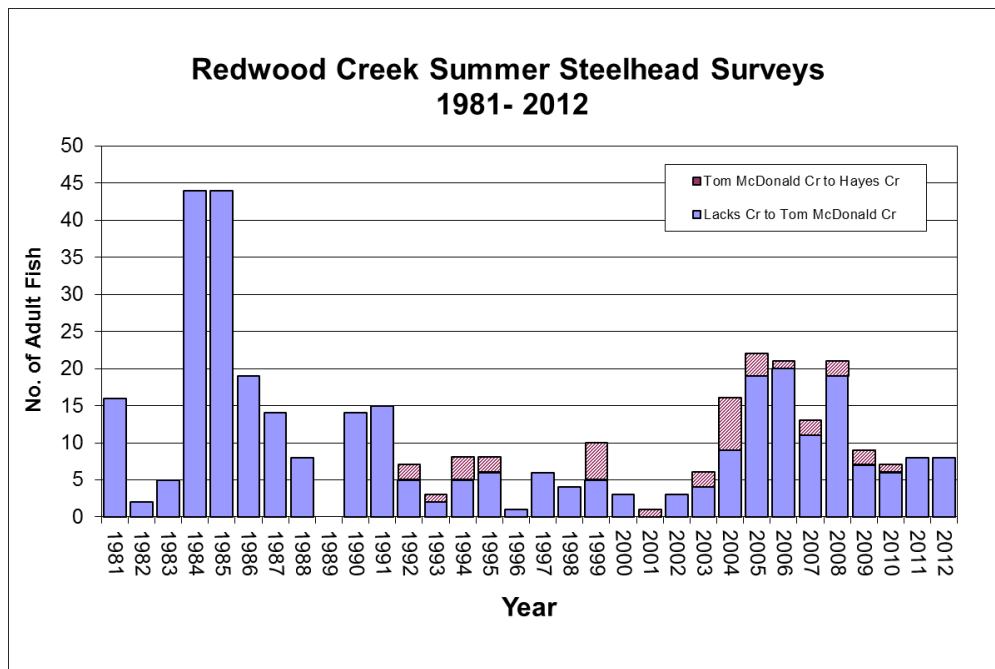


Figure 2. Numbers of summer steelhead observed each summer since 1981 on the 25.9 km index reach of Redwood Creek (Lacks Creek to Tom McDonald Creek), and expanded 13.0 km downstream reach (Tom McDonald Creek to downstream of Hayes Creek), Humboldt County, California. The survey was expanded in 1992.

WATER DISCHARGE

Water flow measured at the Orick gaging station located downstream of the confluence of Prairie Creek at Redwood Creek from July 23 and August 1 ranged between 82 and 106 cfs. (This USGS/DWR flow data is provisional and subject to revision).

WATER TEMPERATURE

Temperature loggers recorded Redwood Creek mainstem water temperature (°C) at two sites during the summer. Water temperature of tributaries was measured with a hand held thermometer below the water surface during the survey. At each tributary, mainstem Redwood Creek temperature was measured immediately upstream of the tributary confluence.

Mainstem Redwood Creek - Redwood Creek water temperatures hand measured during the 2012 survey ranged from 16.5°C (at 10:25) to 22.0°C (at 11:25) (Appendix III).

Onset Tidbit recording temperature loggers were placed mid-depth in the current of mainstem Redwood Creek at two locations within the park (and the snorkel survey reach). They recorded temperature at one-hour intervals from June to September 2012.

A temperature logger (Tidbit S/N 1154750) was located upstream of Tom McDonald Creek/Tall Trees Grove (UTM 415937E 4561603N) between June 1 and September 24. Maximum and minimum water temperatures were 22.4°C and 11.6°C, respectively (Figure 3). The average

water temperature was 17.6°C (Std. dev. 2.2°C). For the period July 1 through August 31, the warmer period of the summer, the average water temperature was 19.0°C, the maximum 22.4°C, and the minimum 15.3°C. During the July 1 - August 31 period, the water temperature was at or greater than 18°C 72.4 percent of the time. Average water temperature in June was 15.3°C; in July, 18.6°C; in August, 19.4°C; and for September 1 to 24, 16.8°C.

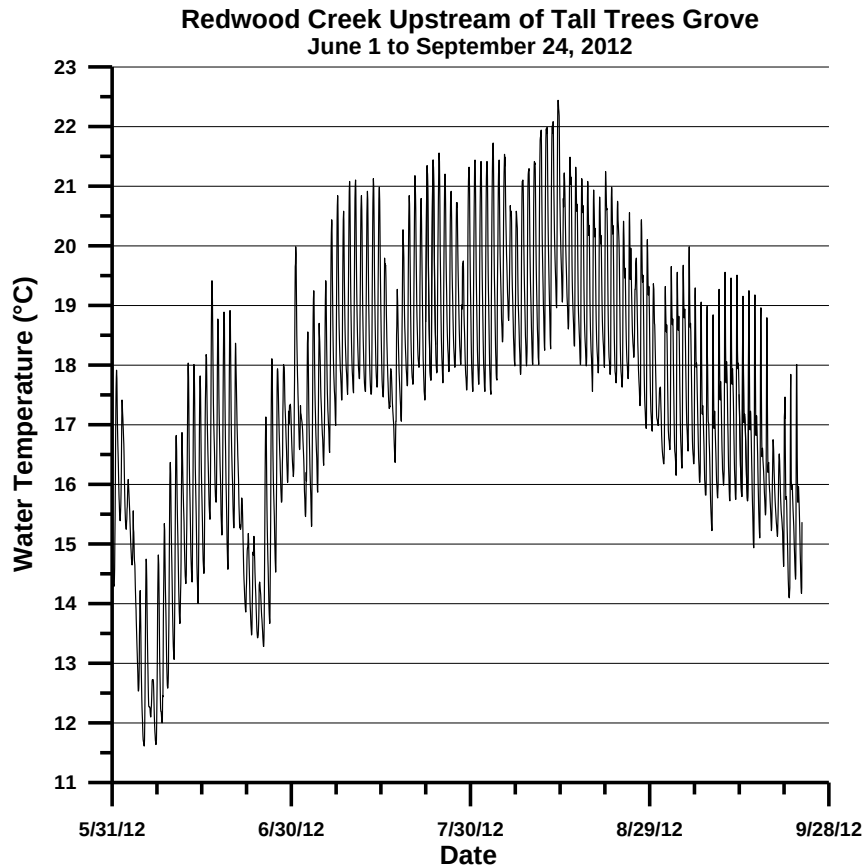


Figure 3. Mainstem Redwood Creek water temperatures (°C) from Onset TidBit temperature logger located upstream of Tom McDonald Creek/Tall Trees Grove at 22.05 river km. The logger situated in the current below the surface recorded water temperature every hour from June 1 through September 24, 2012.

The second temperature logger (Tidbit S/N 9759081) was located in lower Redwood Creek upstream of the Redwood Creek trailhead (UTM 413635E 4572150N) between June 12 and September 24. Maximum and minimum water temperatures recorded between June and September were 21.4°C and 13.4°C, respectively (Figure 4). The average water temperature was 16.9°C (Std. dev. 1.6°C). For the period July 1 through August 31, the warmer period of the summer, the average water temperature was 17.4°C, the maximum 21.4°C, and the minimum 14.5°C. During the July 1 - August 31 period, the water temperature was at or greater than 18°C 27.3 percent of the time. Average water temperature for June 12 to 30 was 15.6°C; for July, 17.2°C; for August, 17.7°C; and for September 1 to 24, 16.6°C.

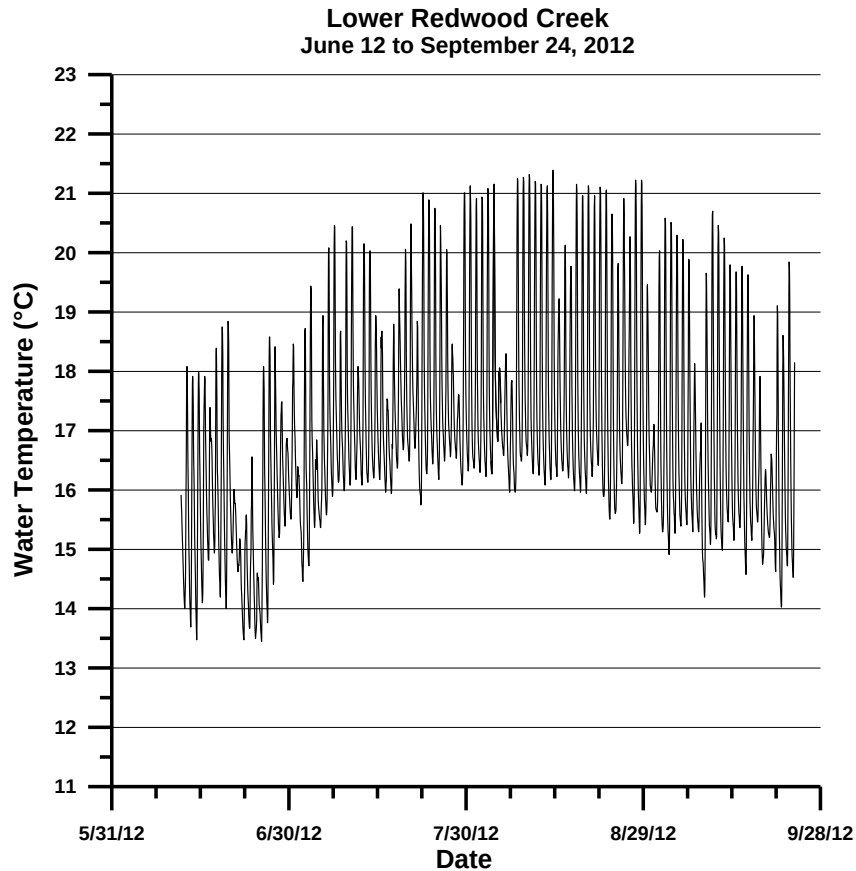


Figure 4. Mainstem Redwood Creek water temperatures (°C) from Onset TempPro temperature logger located upstream of the lower Redwood Creek trailhead parking lot at 7.65 river km. The logger situated in the current below the surface recorded water temperature every hour from June 12 through September 24, 2012.

Tributaries - Water temperatures of 55 tributaries, 24 eastside and 31 westside, of Redwood Creek measured during the survey. Temperatures ranged from 10.5°C (an unnamed westside tributary at 39.90 river km) to 15.0°C (Coyote Creek and an unnamed westside tributary at 25.112 river km) (Appendix III). Water temperatures of all tributaries were colder than the corresponding temperature of mainstem Redwood Creek measured at the same time.

Mean westside tributary temperature was cooler than that of eastside tributaries, a pattern repeated in all past summer steelhead surveys, but the difference was 0.4°C. The mean water temperature of westside temperatures was 12.8°C (n= 31, std. dev. 0.9°C) and temperatures ranged from 10.5°C (UNWS39.90 tributary) to 15.0°C (UNWS25.112 tributary). The mean temperature of eastside tributaries was 13.2°C (n=24, std. dev. 1.0) and temperatures ranged from 12.0°C (Oscar Larson, Chris, and Gans South Creeks, and UNES16.6 and UNES11.75 tributaries).

The 2012 year summer water temperatures are similar to temperatures and patterns have been recorded in all past summer steelhead surveys. Water temperatures in mainstem Redwood Creek are high for salmonid fish, above the preferred temperature range reported by Reiser and Bjornn (1979) for steelhead of 7.3°C to 14.6°C.

REFERENCES

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- Reiser, D.W., and T.C. Bjornn. 1979. Influence of forest and rangeland management on anadromous fish habitat in western North America: Habitat requirements of anadromous salmonids. USDA, Forest Service General Technical Report. PNW-96. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 54 pp.
- Roelofs, T.D. 1983. Current status of California summer steelhead (*Salmo gairdneri*) stocks and habitat, and recommendations for their management. Report to U.S. Department of Agriculture, Forest Service Region. 119 pp.

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Redwood Creek lamprey on redd (RNP July 23, 2012).

Appendix I. Numbers of summer steelhead trout observed 1981 through 2012 and annual survey dates in the 25.9-km (16.1-mile) index reach (Lacks Creek to Tom McDonald Creek) and expanded survey reaches of Redwood Creek, Humboldt County, California by Redwood National and State Parks personnel and others.

Year	Original Index Reach (Lacks Creek to Tom McDonald Creek) No. of Summer Steelhead	Total Reach Surveyed		Survey Dates
		Total No. of Summer Steelhead	Start to End Points and Distance (km)	
1981	16	16	Beaver Cr to Orick (51.5)	8/10 – 13/81
1982 ^a	2	2	Stover Cr to Emerald Cr (22.5)	10/12 & 14/82
1983	5	7	HWY 299 to Tom McDonald Cr (44.4)	8/22 – 25/83
1984	44+	44+	Index Reach (25.9)	8/08 – 10/84
1985	44+	44+	Index Reach (25.9)	8/20 - 22, 9/4/85
1986	19	19	Index Reach (25.9)	8/25 – 27/86
1987	14	15	1mile downstream of Snow Camp Cr to Tom McDonald Cr (72.7)	7/14 – 16/87
1988	8	8 (6 Spring chinook)	Index Reach (25.9)	7/26 – 28/88
1989 ^b	0	0	Lacks Cr to Bridge Cr (17.9)	7/31, 8/01 – 02/89
1990	14	14	Index Reach (25.9)	7/31, 8/01-03/90
1991	15	15	Index Reach (25.9)	8/05 – 08/91
1992	5 (4 & 1 carcass)	7 (6 & 1 carcass)	Lacks Cr to Hayes Cr (37.8)	8/03 - 06, 10/92
1993	2	3	Lacks Cr to Hayes Cr (37.8)	8/02 - 05, 09/93
		2 ^c	Chezem Rd to Stover Cr (24.75)	8/18, 20, 27/93
		3 ^d	Ayres Cabin to Chezem Rd (14.3)	8/28 & 30/93
		8 Total	76.9 km	
1994	5	8	Lacks Cr to Hayes Cr (37.8)	8/01 – 04/94
		16 ^c	Chezem Rd to Stover Cr (24.8)	8/04-06/94
		3 ^e	HWY299 to Chezem Rd (2.0)	8/15/94
		9 ^d	Bradford Cr to HWY 299 (20.1)	8/13-14/94
		36 Total	84.7 km	

Year (cont.)	Index Reach (Lacks Creek to Tom McDonald Creek) No. of Summer Steelhead	Total Reach Surveyed		Survey Dates
		Total No. of Summer Steelhead in total reach	Begin to End Creeks and Distance (km)	
1995	6 (5 & 1 carcass)	8 (7 & 1 carcass)	Lacks Cr to Hayes Cr (37.8)	7/24 – 27/95
		8 ^c	Chezem Rd to Bair Rd (7.6)	8/28/95
		2 ^d	Bradford Cr to Ayres Cabin (7.85)	9/02/95
		18 Total	53.25 km	
1996	1	1	Lacks Cr to Hayes Cr (37.8)	8/05 – 08/96
		21 ^c	Chezem Rd to Stover Cr (24.8)	7/31, 8/1, 22/96
		1 ^d	Bradford Cr to Chezem Rd (22.1)	8/10-12/96
		23 Total	84.7 km	
1997	6	6	Lacks Cr to Hayes Cr (37.8)	8/04 - 07/97
		16 ^c	Chezem Rd to Stover Cr (24.8)	8/06 – 08/97
		15 ^d	Bradford Cr to Chezem Rd (22.1)	8/17, 24, 30/97
		37 Total	84.7 km	
1998	4	4	Lacks Cr to Hayes Cr (37.8)	7/27 – 30/98
		21 ^d	Bradford Cr to Stover Cr (46.9)	8/24-27, 31/98
		25 Total	84.7 km	
1999	5	10	Lacks Cr to Hayes Cr (38)	8/02-05, 09-10/99
2000	3	3	Lacks Cr to Hayes Cr (38)	8/01-03, 07-09/2000
2001	0	1	Lacks Cr to Hayes Cr (38.1)	7/31, 8/01-02, 07/2001
2002	3	3	Lacks Cr to Hayes Cr (38.1)	7/29-31, 8/ 1, 5, 7/2002
2003	4	6	Lacks Cr to Downstream of Hayes Cr (38.8)	7/29-31, 8/4-6/2003
2004	8 (+ 1 dead)	15 (+ 1 dead)	Lacks Cr to Downstream of Hayes Cr (39.0)	7/27-29, 8/3-5/2004
2005	19	22 (1 sockeye salmon)	Lacks Cr to Downstream of Hayes Cr (38.9)	7/26-28, 8/2-4/2005

2006	19 (+ 1 dead)	20 (+ 1 dead)	Lacks Cr to Downstream of Hayes Cr (38.9)	7/25-27 & 31, 8/1-2/2006
2007	11	13 (1 sockeye salmon)	Lacks Cr to Downstrm of Hayes Cr (38.9)	7/24-26, 30, 31, 8/1/2007
2008	19	21	Lacks to Downstream of Hayes (38.9)	7/28-31, 8/4-6/2008
		9 ^f	Chezem Rd Bridge to Bair Rd Bridge (7.65)	7/28/2008
		6 ^f	Bair Rd Bridge to Beaver Cr (7.4)	7/29/2008
		23 ^f	Beaver Cr to Stover Cr (8.8)	7/30/2008
		59 Total	62.75 km	
2009	7	9	Lacks Cr to Downstream of Hayes Cr (38.9)	7/27-30, 8/3-5/2009
2010	6	7	Lacks Cr to Downstream of Hayes Cr (38.9)	7/26 – 29, 8/2-4/2010
2011	8	8	Lacks Cr to Downstream of Hayes Cr (38.9)	7/26, 27, 8/1-4, 8/2011
2012	8 (including 1 dead)	8 (including 1 dead)	Lacks Cr to Downstream of Hayes Cr (38.9)	7/23-26, 30, 31, 8/1/2012
^a Survey from Stover Creek to Emerald Creek, 14 miles, covering most of index section and best pool habitat. ^b Survey from Lacks to Bridge Creek, minus Garret to Panther Creek, a total of 11.1 miles. Covered best pool habitat. ^c Tom Weseloh – California Trout ^d Matt Smith –North Coast Fisheries Restoration ^e Kirk Cohune ^f Tom Weseloh,- California Trout and Tom Shaw – USFWS-Arcata Office				

Appendix II. Location, number, and sizes if noted of Western Pearlshell (*Margaritifera falcate*) mussels observed during the 2011 summer steelhead survey of mainstem Redwood Creek. (River kilometer from the 2011 river maps)

Date	River Km	Number	Sizes	Notes
7/24/2012	31.15	5	---	Queen's Hole pool bank. Persistent population (UTM 421275E 4556425N)
7/25/2012	25.45	13	¾" and larger	On silty bank behind house sized boulders. (UTM: 418417E 4560253N)
7/26/2012	~23.60	--	--	At head of pool upstream of Emerald Creek. Persistent population.
7/30/2012		1	---	UTM 415859E/4561794
7/30/2012	19.05	27	Large & small	10 small mussels. UTM 415529E 4563110N
7/31/2012	~11.35	½		One half shell in pool below Elam Creek.
Total Observed		48+		



Breaking camp, packing waterproof bags at gravel bar on Redwood Creek (RNP 2012)

Appendix III. Water temperatures (°C) measured during the 2012 Redwood Creek summer steelhead trout survey from July 23 to August 1. Locations are listed south to north. Redwood Creek (upstream) refers to water temperature measurement taken immediately upstream of the tributary confluence listed below. UN ES or UN WS refers to unnamed eastside or westside tributary, and the number refers to river kilometer (measured from the mouth of Redwood Creek). Alignment refers to tributary watershed position: East = Eastside, West = Westside, and REDW = mainstem Redwood Creek. **SSHD** = water temperatures at summer steelhead locations. (Handheld thermometer with 0.5°C increments)

Location	Alignment	Date	Time	Water Temperature (°C)	Confluence Connection
Redwood Creek (upstream)	REDW	8/1/2012	8:20	16.5	
Lacks Creek	East	8/1/2012	8:20	14.0	connected
George Creek	West	8/1/2012	9:04	12.0	connected
Redwood Creek (upstream)	REDW	8/1/2012	10:45	17.0	
UN ES 44.0	East	8/1/2012	10:45	12.5	----
Redwood Creek (upstream)	REDW	8/1/2012	11:18	17.0	
Garrett Creek	East	8/1/2012	11:18	14.0	Subsurface
Redwood Creek (upstream)	REDW	8/1/2012	13:32	19.0	
Carson Creek	East	8/1/2012	13:32	14.5	---
UN ES 41.25	East	8/1/2012	14:21	14.0	---
Redwood Creek	REDW	8/1/2012	14:53	19.0	
Redwood Creek (upstream)	REDW	7/23/2012	10:50	18.0	
Panther Creek	West	7/23/2012	10:50	12.0	connected
Redwood Creek (upstream)	REDW	7/23/2012	11:52	18.0	
UN WS 39.90	West	7/23/2012	11:52	10.5	---
Redwood Creek (upstream)	REDW	7/23/2012	12:24	18.0	
UN WS 39.25	West	7/23/2012	12:24	13.0	---
Redwood Creek (upstream)	REDW	7/23/2012	12:35	18.0	
Joplin Creek	West	7/23/2012	12:35	13.0	---
Redwood Creek (upstream)	REDW	7/23/2012	14:30	19.0	
UN WS 37.75	West	7/23/2012	14:30	13.5	---
Redwood Creek (upstream)	REDW	7/23/2012	15:50	19.0	
Coyote Creek	East	7/23/2012	15:50	15.0	connected
Redwood Creek (upstream) 35.75 SSHD	REDW	7/23/2012	16:50	19.0	
UN ES 35.7384	East	7/23/2012	16:50	14.0	---
Redwood Creek (upstream)	REDW	7/23/2012	18:00	19.5	
Devils Creek	West	7/23/2012	18:00	13.0	connected
Redwood Creek 33.875	REDW	7/24/2012	9:04	17.0	---
Redwood Creek (upstream)	REDW	7/24/2012	9:24	17.5	
Lyons Creek	East	7/24/2012	9:24	13.0	---
Redwood Creek (downstream)	REDW	7/24/2012	10:25	17.5	
Elf Creek	West	7/24/2012	10:25	12.5	connected
UN WS 32.527	West	7/24/2012	10:45	13.0	---
Redwood Creek (upstream)	REDW	7/24/2012	11:11	18.0	
Copper Creek	East	7/24/2012	11:11	14.5	connected

Location	Alignment	Date	Time	Water Temperature (°C)	Confluence Connection
Redwood Creek 31.23 km SSHD	REDW	7/24/2012	12:30	18.0	
Redwood Creek (upstream)	REDW	7/24/2012	14:05	19.5	
UN WS 31.042	West	7/24/2012	14:05	14.5	---
Redwood Creek (upstream)	REDW	7/24/2012	14:55	20.0	
UN WS 29.853	West	7/24/2012	14:55	14.0	---
UN WS 29.80	West	7/24/2012	15:09	14.0	---
Redwood Creek (upstream)	REDW	7/25/2012	8:58	17.5	
UN WS 29.80	West	7/25/2012	8:58	13.0	---
Redwood Creek (upstream)	REDW	7/25/2012	9:35	17.5	
UN WS 29.0	West	7/25/2012	9:35	12.0	---
Redwood Creek (upstream)	REDW	7/25/2012	9:57	17.5	
UN WS 29.066	West	7/25/2012	9:57	13.0	---
Slide Creek	East	7/25/2012	10:07	14.0	connected
Redwood Creek (upstream) 28.25 SSHD	REDW	7/25/2012	11:04	18.0	
UN WS 28.243	West	7/25/2012	11:04	13.5	---
Redwood Creek 27.25 SSHD	REDW	7/25/2012	14:10	20.0	
Redwood Creek 26.98 SSHD	REDW	7/25/2012	14:40	20.0	
Redwood Creek (upstream)	REDW	7/25/2012	14:56	20.0	
UN WS 26.6861	West	7/25/2012	14:56	13.0	---
Redwood Creek (upstream)	REDW	7/25/2012	15:57	20.5	
Dolason Creek	East	7/25/2012	15:57	14.5	subsurface 20m
Redwood Creek (upstream)	REDW	7/25/2012	16:33	20.5	
UN WS 25.112	West	7/25/2012	16:33	15.0	---
Bridge Creek	West	7/25/2012	17:10	14.0	connected
Redwood Creek (upstream)	REDW	7/26/2012	8:30	18.0	
Bridge Creek	West	7/26/2012	8:30	13.0	connected
Redwood Creek (upstream)	REDW	7/26/2012	10:05	18.0	
Emerald Creek	East	7/26/2012	10:05	13.0	connected
UN WS 22.861	West	7/26/2012	10:25	13.0	---
Redwood Creek 21.90 SSHD	REDW	7/26/2012	11:25	22.0	
Redwood Creek (upstream)	REDW	7/26/2012	12:02	18.5	
UN ES 21.20	East	7/26/2012	12:02	13.5	---
Redwood Creek (upstream)	REDW	7/26/2012	12:40	19.0	
Tom McDonald Creek	West	7/26/2012	12:40	13.0	---
Redwood Creek 19.25 km	REDW	7/30/2012	10:00	16.5	
UN ES ---	East	7/30/2012	---	13.0	---
UN ES 18.9974	East	7/30/2012	---	12.5	---
Cole Creek	East	7/30/2012	---	13.0	connected
Fortyfour Creek	West	7/30/2012	11:03	12.0	connected
UN ES 17.4644	East	7/30/2012	11:27	12.5	---
UN WS 17.37	West	7/30/2012	11:31	11.0	---
Miller Creek	East	7/30/2012	11:39	12.5	connected
UN ES 16.60	East	7/30/2012	12:36	12.0	---
Redwood Creek (upstream)	REDW	7/30/2012	13:16	19.0	

Location	Alignment	Date	Time	Water Temperature (°C)	Confluence Connection
Bond Creek	West	7/30/2012	13:16	12.5	---
Redwood Creek (upstream)	REDW	7/30/2012	13:34	19.0	
UN WS 15.80	West	7/30/2012	13:34	13.0	---
Redwood Creek (upstream)	REDW	7/30/2012	14:13	19.0	
UN WS 14.75	West	7/30/2012	14:13	13.0	---
Redwood Creek (upstream)	REDW	7/30/2012	14:23	19.5	
Cloquet Creek	East	7/30/2012	14:19	12.5	---
Redwood Creek 14.60	REDW	7/31/2012	10:05	16.5	---
Redwood Creek (upstream)	REDW	7/31/2012	10:25	16.5	
UN WS 13.95	West	7/31/2012	10:25	12.0	subsurface
Redwood Creek (upstream)	REDW	7/31/2012	10:35	17.0	
UN WS 13.806	West	7/31/2012	10:35	12.0	---
Redwood Creek (upstream)	REDW	7/31/2012	11:04	18.0	
Oscar Larson Creek	East	7/31/2012	11:04	12.0	subsurface
Redwood Creek (upstream)	REDW	7/31/2012	11:28	17.0	
Chris Creek	East	7/31/2012	11:28	12.0	---
Redwood Creek (upstream)	REDW	7/31/2012	11:38	18.0	
UN WS 12.73	West	7/31/2012	11:38	13.0	subsurface
Redwood Creek (upstream)	REDW	7/31/2013	11:52	18.5	
Gans South Creek	East	7/31/2013	11:52	12.0	subsurface
UN ES 11.75	East	7/31/2012	12:35	12.0	connected
Elam Creek	West	7/31/2012	13:48	13.0	---
Redwood Creek (upstream)	REDW	7/31/2012	14:43	19.0	
McArthur Creek	West	7/31/2013	14:43	12.0	---



Summer Steelhead survey campsite on Redwood Creek gravel bar (RNP 2012)