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Mainstem Klamath River Fall Chinook Salmon Spawning Survey 2006

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Key words: Chinook salmon, Klamath River, redd, escapement, spawning survey

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Abstract. Results of the fourteenth annual US Fish and Wildlife Service fall Chinook salmon *Oncorhynchus tshawytscha* spawning survey conducted on the mainstem Klamath River are summarized. The survey was conducted over a seven-week period (October 16 to November 29, 2006), covering 136.5 river kilometers (rkm; 84.9 river miles; six reaches) between Iron Gate Dam (rkm 310.3) and Indian Creek (rkm 173.8). A total of 1,186 redds were observed during the 2006 survey, representing the tenth highest redd count since surveys began in 1992. The 2006 count for Reaches 2 thru 6 was 733 redds which was 19% less than the previous 13 year average ($\bar{x} = 904$), but higher than the 2005 count of 268 redds. Redd densities were highest between Iron Gate Dam and Cape Horn Creek (rkm 310.3 to 300.6; 43.2 redds/rkm), and lowest between Humbug Creek and Vesa Creek (rkm 279.7 to 268.3; 1.6 redds/rkm). Water clarity between Iron Gate Dam and Indian Creek ranged from 0.6 to 3.0 m ($n = 18$) and was slightly less than average. During 2006, no redds were observed on suction dredge tailings between Iron Gate Dam and Indian Creek.

Introduction

The Klamath River drains approximately 14,000 km² in Oregon and 26,000 km² in California. The majority of the watershed in California is within the boundaries of the Six Rivers, Klamath and Shasta-Trinity National Forests. The Yurok Indian Reservation, comprising about 139 km² in Humboldt and Del Norte counties, borders the lower 68 km of the Klamath River (Figure 1). The most important anadromous salmonid spawning tributaries in the basin include the Trinity River (the largest tributary in the basin) draining approximately 7,690 km², and the Shasta, Scott and Salmon rivers, each draining about 2,070 km². Iron Gate Dam (IGD), located at river kilometer (rkm) 310.3 on the Klamath River and Lewiston Dam located on the Trinity River, are barriers to upstream passage of anadromous salmonids. Iron Gate Hatchery (IGH) and Trinity River Hatchery, located near the base of each dam, mitigate for losses in natural fish production that resulted from dam construction (USFWS 1991).

The Klamath River Basin historically supported large runs of Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead trout (*O. mykiss*),

which contribute to economically and culturally important subsistence, sport and commercial fisheries (Leidy and Leidy 1984). Generations of Indians have fished in the drainage, with catches of salmon, steelhead, lamprey, and sturgeon being very important natural resources. Sport fishing for salmon and steelhead in the drainage may exceed 200,000 angler days annually (Leidy and Leidy 1984). During the 1980's, the Klamath River stocks accounted for up to 30% of commercial Chinook salmon landings in northern California and southern Oregon, averaging about 450,000 Chinook salmon per year (PFMC 1988).

Concern about the depletion of anadromous salmonid resources and associated habitat in the basin emerged around the turn of the century and has accelerated in recent decades, coincident with expanded logging and fishing operations, construction of dams, road construction, agricultural use, and other development. As in other river systems of the Pacific Northwest, Chinook salmon of the Klamath River Basin are adversely affected by habitat degradation and over-exploitation, as reflected by declining runs in recent decades (USFWS 1991).

On October 27, 1986, the US Congress enacted PL 99-552, the Klamath River Fish and Wildlife Restoration Act. This Act authorized the Secretary of the Interior to restore anadromous fish populations to optimum levels in the Klamath River Basin through the creation of the Klamath River Basin Conservation Area Restoration Program, functioning under the guidance of the Klamath River Fishery Management Council and the Klamath River Basin Fisheries Task Force (USFWS 1991). Since 1993, the AFWO has conducted spawning surveys in the mainstem Klamath River to evaluate the status of salmon escapement below Iron Gate Dam. Data collected as part of these surveys has been and continues to be used by the Klamath River Technical Advisory Team of the Klamath Fisheries Management Council as input to harvest and escapement models for predicting the abundance of salmon in the following years. This report provides results of the 2006 survey, and marks the fourteenth consecutive year that AFWO has conducted these surveys.

Methods

Survey Procedures

Weekly visual redd counts, using 4.3 m inflatable rafts, were conducted on six mainstem reaches from Iron Gate Dam to Indian Creek over a 7 week period from October 16 to November 29, 2006; except during the sixth week (November 20 to 24) due to high flows that limited water clarity. Survey crews consisted of an oarsman and observer. Because of the historical high redd densities in Reach 1, two crews simultaneously floated this reach. One crew surveyed from the stream margin to mid channel on one side of the river and the other surveyed from the stream margin to mid channel on the other side of the river. A single crew surveyed Reaches 2 through 6. Crews were assigned the same survey reaches through the sampling period with the belief that increased familiarity of redd locations would facilitate more accurate accounting of redds.

Survey Reaches

Reach 1: IGD (rkm 310.3) to Deliverance Camp (rkm 287.5). Reach 1 is approximately 22.8 rkm (14.2 miles) in length (Figure 2) and surveys took place Monday and Tuesday. On Mondays, crews completed a section of Reach 1 from the Interstate 5 (I-5) Bridge (rkm 292.7) to Deliverance Camp in approximately two hours of the survey week. On Tuesdays, crews completed the survey from IGD to the I-5 Bridge in 8 to 10 hrs.

Crews did not survey between Deliverance Camp and Ash Creek (rkm 285.7) because past surveys have revealed lack of available spawning habitat. A mark recapture carcass estimator was also used in Reach 1 (from a separate USFWS survey) to derive the number of natural fall Chinook salmon that spawn there.

Reach 2: Ash Creek to Beaver Creek (rkm 261.9). Reach 2 is about 23.8 rkm (14.7 miles) in length (Figure 2). The Ash Creek river access is located on the south bank of the Klamath River. The Beaver Creek river access is located along the north bank on a large gravel bar downstream from Beaver Creek Bridge, just off Highway 96. A crew surveyed this reach on Wednesday of each week in about 7 hrs.

Reach 3: Beaver Creek to Blue Heron (rkm 234.3). Reach 3 is approximately 27.6 rkm (17.1 miles) in length (Figure 2). The Blue Heron river access is about 2 rkm upstream from the Scott River confluence on the south bank of the Klamath River just off Highway 96. A crew surveyed this reach on Wednesday of each week, taking about 8 hrs to complete.

Reach 4: Blue Heron to Seiad Bar (rkm 213.6). Reach 4 is approximately 20.8 rkm (12.9 miles) in length (Figure 2). Seiad Bar access was through Wally Johnson's property. Access to the river is reached from Highway 96 by turning south onto Diamond J road and then turning right onto an unmarked road located near the California Department of Transportation compound. A crew surveyed this reach on Thursday of each survey week, taking an average of about 8-hrs to complete.

Reach 5: Seiad Bar to China Point (rkm 192.4). Reach 5 is approximately 21.2 rkm (13.2 miles) in length (Figure 2). China Point river access is located along the north bank of the river at a US Forest Service (USFS) river access site just off Highway 96. A crew surveyed this reach on Thursday of each week, taking about 7 hrs to complete.

Reach 6: China Point to the Indian Creek (rkm 173.8). Reach 6 is approximately 18.6 rkm (11.6 miles) in length (Figure 2). This reach was split at Gordons Ferry (rkm 185) due to the high concentration of redds in this reach. China Point to Gordons Ferry is about 7.4 rkm (4.6 miles). Gordons Ferry to Indian Creek is about 11.3 rkm (7 miles). The Gordons Ferry river access is located just off Highway 96. Crews surveyed these two sections on Friday of each week, taking approximately 5 hrs each to complete.

Data Collection

Redd Data

Vinyl flagging was used to mark redd locations in the field. Flagging was attached to vegetation on the riverbank nearest to the position of each redd observation. Different colored flagging was used each week to ensure that redds were not double counted during the subsequent surveys. Date, number of redds per site, location in channel, and redd site number were recorded on flags. Redd locations were marked on river maps. River reach, flag location, GPS coordinates, tally number, location in channel (left or right bank, mid-channel, side channel, split channel, and pool tail-out), distance from bank, presence and number of adults and/or grilse occupying the redd, and age of redd were also recorded on data forms. Estimated redd ages were recorded as Redd Age Code 1, 2 or 3 depending on appearance. Redds were classified as Redd Age Code 1 if substrate was bright, there was little or no periphyton, and mounds were developed. Redds were classified as Redd Age Code 2 if two to four weeks old and had slightly flattened mounds and dulled substrate due to periphyton growth. Redds were classified as Redd Age Code 3 if older than four weeks and were identifiable only by the presence of a pit and/or mound. The brightness of substrate on these redds was typically not distinguishable from that of surrounding materials. Only completed redds including both a pit and mound were included in daily counts. Test redds and small ($<1.0 \text{ m}^2$) redds were not counted, but were noted on data forms.

Water Temperature

An Optic Stowaway Tidbit recorded water temperature on an hourly basis throughout the survey period at the Iron Gate Hatchery Bridge (rkm 309.8). Mean daily water temperatures were calculated from hourly measurements.

Discharge

Mean daily river flow obtained from the US Geological Survey gauging station (Number 11516530; Latitude $41^{\circ} 55' 41''$, Longitude $122^{\circ} 26' 35''$ NAD 27; <http://waterdata.usgs.gov/ca/nwis/current/?type=flow>), located in the Klamath River just downstream of IGD and were recorded in ft^3/s .

Water Clarity

Water clarity was measured each day and in each reach of the survey by lowering a 20-cm diameter Secchi disc vertically into the water column. The disc was lowered until the black and white pattern was not discernable, and then raised until the pattern became visible; this depth was recorded in meters.

Data Analysis

Redd Densities

The density of redds per unit length of river was determined to examine the spatial distribution of redds in the area of study. Redd density was examined by the six primary survey reaches and 10 kilometer sections (sub reaches), the latter of which was completed to provide improved spatial resolution of locations of redds for future evaluations. Summarization of redd densities was facilitated through use of a database.

Adult and Grilse Expansion

The total number of redds counted in this survey was used by California Department of Fish and Game (CDFG) to estimate adult and grilse (two year old) spawning abundance (CDFG 2007). Adult numbers were calculated by multiplying the total redd count by two. This estimate assumes one male and female salmon per redd. The adult age breaks and grilse apportionment for the mainstem Klamath River from IGD to Indian Creek was derived from scales and fork length data collected during carcass surveys in Reach 1 (KRTAT 2007).

Results and Discussion

A total of 1,186 fall Chinook salmon redds were counted between Iron Gate Dam and the confluence of Indian Creek, which is the tenth highest count since the initiation of these surveys (Table 1). The highest number of Chinook salmon redds/rkm was in Reach 1 (Figure 3), and the lowest was in Reach 2 (Reach 5 usually has the lowest count). The 2006 survey for reaches 2 thru 6 was the seventh highest count ($n = 733$) since the initiation of these surveys (Figure 4).

Survey Reaches

Reach 1: IGD to Deliverance Camp. A total of 453 redds were observed in this reach during the 2006 survey (Table 1; Figure 5). The 453 redds represent 38 % of the total redd count for 2006. Redd density was 20.3 redds/rkm (Figure 3). Crews observed peak spawning during the second week (October 23 to October 27) of the survey (Table 1). The 453 redd observed in this reach represent the second lowest count since the project started in 1993 (Table 1).

Reach 2: Ash Creek to Beaver Creek. A total of 57 redds were observed in this reach during the 2006 survey (Table 1; Figure 6). The 57 redds represent 5% of the total redd count for 2006. Redd density was 2.4 redds/rkm (Figure 3). Peak spawning ($n = 17$) was observed during the second week (October 23 to October 27) of the survey (Table 1). Reach 2 had the lowest redd count ($n = 57$) of any reach during the 2006 survey. The 57 redds counted in this reach represent the third lowest count since the project started in 1993 (Table 1).

Reach 3: Beaver Creek to Blue Heron. A total of 117 redds were counted in this reach during the 2006 survey (Table 1; Figure 7), comprising 10% of the total redd count for the season. Redd density was 4.2 redds/rkm (Figure 3). Peak spawning ($n = 41$) in Reach 3 was observed during the first week (October 16 to October 20) of the survey (Table 1). The 117 redds observed during the survey is the fourth lowest count for this reach since the project started in 1993 (Table 1).

Reach 4: Blue Heron to Seiad Bar. A total of 146 redds were counted in Reach 4 during the 2006 survey (Table 1; Figure 8), representing 12 % of the total redd count for the season. Redd density was 7.0 redds/rkm (Figure 3). Peak spawning ($n = 66$) in Reach 4 occurred during the first week (October 16 to October 20) of the survey. The

146 redds observed during the survey is the seventh lowest count for this reach since the project started in 1993 (Table 1).

Reach 5: Seiad Bar to China Point. A total of 71 redds were counted in this reach during the 2006 survey (Table 1; Figure 9), accounting for 6 % of the season total. Redd density was 3.3 redds/rkm (Figure 3). Peak spawning (n = 31) occurred during the first week (October 16 to October 20) of the survey. Reach 5 had the eighth lowest count for the reach since the project started in 1993 (Table 1).

Reach 6: China Point to Indian Creek. A total of 342 redds were counted in Reach 6 (Table 1; Figure 10), representing 29 % of the total redd count for 2006. The estimated redd density was 18.3 redds/rkm (Figure 3). Peak spawning (n = 155) in Reach 6 occurred during the first week (October 16 to October 20) of this survey (Table 1). Reach 6 had the eleventh lowest count for the reach since the project started in 1993 (Table 1).

All Reaches

Spawning was observed throughout the mainstem river from Iron Gate Dam to Indian Creek and was slightly different than previous survey data in that spatial distribution of redds was lower in Reach 2 (2.4 redds/rkm) than Reach 5 (3.3 redds/rkm). However, it was still highest in Reach 1 (20.3 redds/rkm) and Reach 6 (18.3 redds/rkm; [Table 1; Figure 3]). Redd densities were intermediate for reaches 3 and 4 (Table 1; Figure 3). The highest weekly redd count occurred during late October, similar to most (12 of 14) survey years. Overall, the 2006 redd survey yielded the tenth highest count (although the 2005 count only included the lower 5 reaches) during the period of record (1993 to 2006; Figure 4).

Water Temperature

Mean daily water temperatures decreased from 15 to 8.4°C during this survey (October 16 to November 29, 2006). Water temperatures continued to decrease during the surveys, even though IGD flows climbed from 1,280 to 1,330 and then dropped to 1,310 cfs (Figure 11).

Discharge

Discharge during the 2006 survey period ranged from 1,280 to 1,330 cfs (Figure 11). Mean daily discharges were lowest (914 to 943 cfs) during the 2004 survey and the 2006 discharges were similar to those experienced in 2001 (1,300 to 1,410 cfs) and 2005 (1,320 to 1,410 cfs).

Water Clarity

Vertical Secchi disc readings ranged from 0.6 to 3.0 m (n = 18) during this survey compared to 2.1 to 3.0 m in 2005. The 0.6 m reading occurred on November 1, 2006 in Reach 3. The 3.0 m reading occurred on October 17, 2006 in Reach 1. The lower range of water clarity in 2006 was less (0.6 versus 2.0 m) than that experienced in 2005, though the upper range was the same (3.0 m). Visibility generally decreased with higher river discharge, cloud cover, and precipitation.

Suction Dredge Mining

Recreational suction dredge mining was present throughout the survey from Ash Creek to Happy Camp. No redds were observed in 2006 on suction dredge tailings. Studies have indicated that redds constructed on dredge tailings are more unstable in high flows than if constructed on naturally deposited substrate (Harvey and Lisle 1999).

10 rkm Section Redd Densities

Redd densities for the fourteen 10 rkm sections in 2006 were highest (43.2 redds/rkm) between Iron Gate Dam and Cape Horn Creek. Redd densities in 2006 were higher than in 2005 for all but one (Section 3) of the surveyed sections (Sections 3 thru 14). In 2006, the lowest redd density (1.6 redds/rkm) was observed between Humbug and Vesa Creek (Table 2; Figure 6).

Adult Grilse Expansion

The CDFG estimated the natural fall Chinook salmon spawner escapement for the mainstem Klamath River during 2006 at 14,264 adults and 6,516 grilse (Table 3). The Iron Gate Hatchery returns in 2006 were 11,604 adults and 2,386 jacks. Based on spawning data from mainstem and tributary spawning surveys conducted by AFWO, USFS, CDFG, and Hoopa and Yurok tribes, the CDFG estimated that 70,530 adults spawned in-river or at hatcheries within the Klamath River Basin.



Figure 1. Overview map of the Klamath River Basin accessible to fall Chinook salmon.

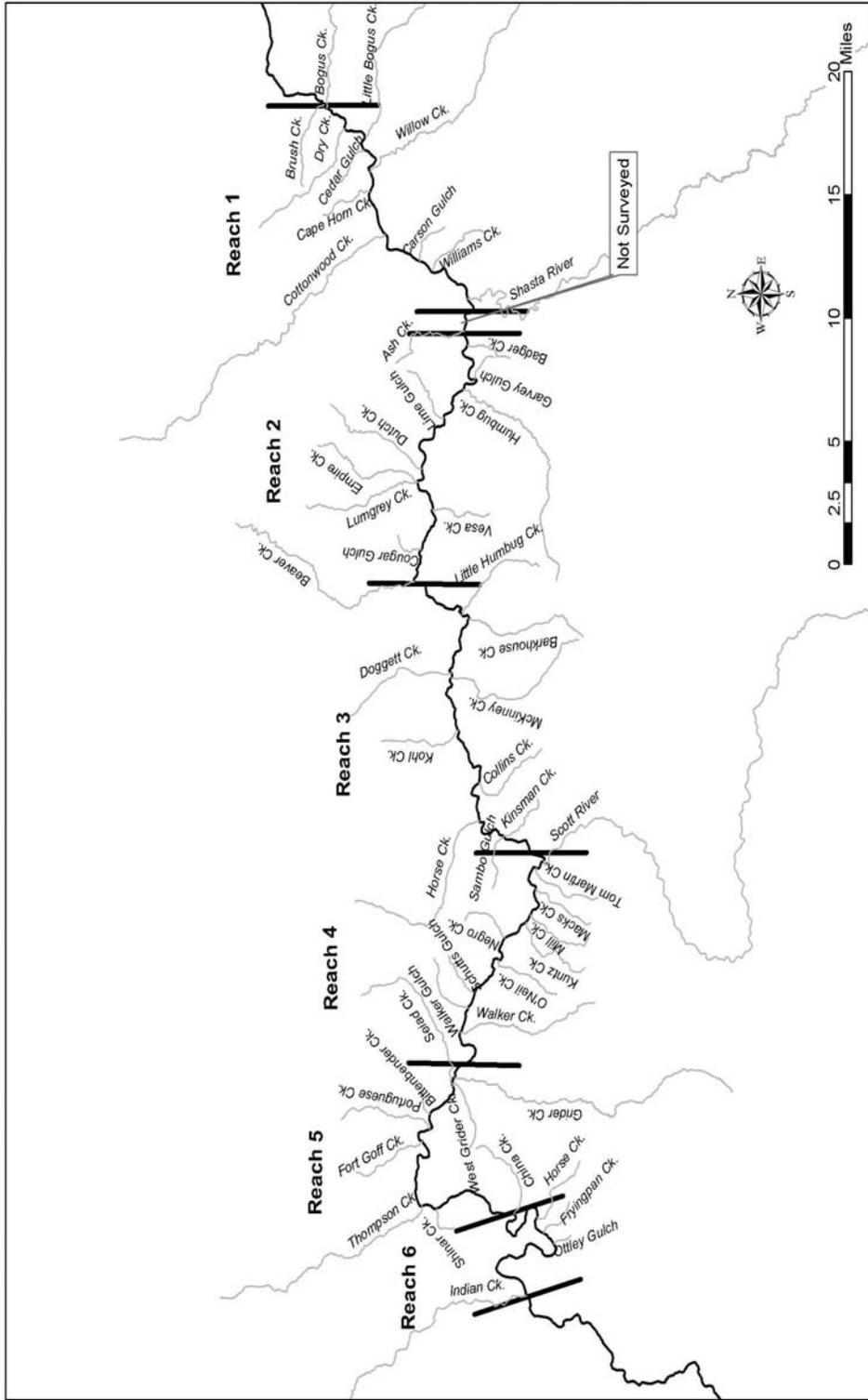


Figure 2. Mainstem Klamath River Chinook salmon spawning survey project location including individual study reaches (1 to 6).

Table 1. Weekly summary and percent frequency of mainstem Klamath River fall Chinook salmon redd counts for Reaches 1 to 6, 1993 to 2006 (NS = No Survey, R1 = Iron Gate Dam to Ash Creek , R2 = R1 to Beaver Creek, R3 = R2 to Blue Heron, R4 = R3 to Seiad Bar, R5 = R4 to China Point, R6 = R5 to Indian Creek).

Year	Week	Reach						Total
		R1	R2	R3	R4	R5	R6	
1993	Oct 25 to 29	15	13	30	18	16	81	173
	Nov 1 to 5	67	24	4	1	15	5	116
	Nov 8 to 12	5	1	18	7	0	1	32
	Nov 15 to 18	0	0	4	5	0	0	9
	Total	87	38	56	31	31	87	330
	% Frequency	26	12	17	9	9	26	
1994	Oct 17 to 21	89	28	48	Ns	Ns	98	263
	Oct 24 to 28	278	59	77	113	98	124	749
	Oct 31 to Nov 4	375	20	46	42	16	33	532
	Nov 7 to 11	86	Ns	Ns	Ns	Ns	Ns	86
	Nov 14 to 18	3	2	7	4	5	5	26
	Total	831	109	178	159	119	260	1,656
% Frequency	50	7	11	10	7	16		
1995	Oct 16 to 20	138	12	70	26	30	139	415
	Oct 23 to 27	598	82	199	94	91	169	1,233
	Oct 30 to Nov 3	727	58	78	35	57	112	1,067
	Nov 6 to 10	277	26	49	13	25	50	440
	Nov 13 to 17	Ns	Ns	Ns	Ns	Ns	Ns	0
	Nov 20 to 24	Ns	Ns	Ns	Ns	Ns	Ns	0
	Nov 27 to Dec 1	39	9	14	4	12	3	81
Total	1,779	187	410	172	215	473	3,236	
% Frequency	55	6	13	5	7	15		
1996	Oct 21 to 25	290	31	96	10	118	39	584
	Oct 28 to Nov 1	291	29	25	22	42	92	501
	Nov 4 to 8	83	4	24	8	33	59	211
	Nov 11 to 15	40	0	6	0	7	23	76
	Total	704	64	151	40	200	213	1,372
% Frequency	51	5	11	3	15	16		
1997	Oct 16	272	Ns	Ns	Ns	Ns	Ns	272
	Oct 20 to 24	252	37	69	89	29	136	612
	Oct 27 to 31	424	18	76	52	22	76	668
	Nov 3 to 7	70	7	13	16	8	27	141
	Nov 10 to 14	2	14	4	5	3	18	46
	Total	1,020	76	162	162	62	257	1,739
% Frequency	59	4	9	9	4	15		
1998	Oct 14 to 15	89	Ns	Ns	Ns	Ns	Ns	89
	Oct 19 to 23	180	45	67	15	20	45	372
	Oct 26 to 30	368	11	12	14	7	39	451
	Nov 2 to 6	226	22	33	10	9	28	328
	Nov 9 to 12	135	3	11	3	2	2	156
	Nov 15 to 19	12	1	3	0	1	2	19
	Total	1,010	82	126	42	39	116	1,415
% Frequency	71	6	9	3	3	8		

Table 1. (Continued). Weekly summary and percent frequency of mainstem Klamath River fall Chinook salmon redd counts for Reaches 1 to 6, 1993 to 2006 (NS = No Survey, R1 = Iron Gate Dam to Ash Creek, R2 = R1 to Beaver Creek, R3 = R2 to Blue Heron, R4 = R 3 to Seiad Bar, R5 = R4 to China Point, R6 = R5 to Indian Creek).

Year	Week	Reach						Total
		R1	R2	R3	R4	R5	R6	
1999	Oct 13 to 15	98	3	Ns	Ns	Ns	Ns	101
	Oct 18 to 22	200	27	31	17	23	39	337
	Oct 25 to 27	304	23	20	Ns	Ns	Ns	347
	Nov 1 to 5	83	12	9	8	8	19	139
	Nov 8 to 12	37	2	2	1	5	11	58
	Nov 15 to 19	1	2	0	2	2	0	7
	Total	723	69	62	28	38	69	989
	% Frequency	73	7	6	3	4	7	
2000	Oct 16 to 20	327	92	69	25	10	19	542
	Oct 23 to 27	146	62	34	52	10	53	357
	Oct 30 to Nov 3	254	42	69	54	20	86	525
	Nov 6 to 10	57	12	15	21	2	16	123
	Nov 13 to 17	4	0	9	12	0	6	30
	Nov 20 to 22	1	Ns	Ns	Ns	Ns	Ns	1
	Total	788	208	196	164	42	180	1,578
	% Frequency	50	13	12	10	3	11	
2001	Oct 15 to 19	92	24	28	21	2	23	190
	Oct 22 to 26	168	102	128	59	40	82	579
	Oct 29 to Nov 2	323	97	170	102	55	139	886
	Nov 5 to 9	155	10	40	12	31	29	277
	Nov 12 to 16	75	31	49	22	9	Ns	186
	Nov 19 to 23	Ns	Ns	Ns	Ns	Ns	Ns	0
	Nov 26 to 30	17	Ns	Ns	Ns	Ns	Ns	17
	Dec 3 to 7	Ns	Ns	12	Ns	Ns	5	17
	Dec 10 to 14	Ns	5	8	4	3	Ns	20
	Total	830	269	435	220	140	278	2,172
% Frequency	38	12	20	10	6	13		
2002	Oct 10	8	Ns	Ns	Ns	Ns	Ns	8
	Oct 15 to 18	124	90	120	71	61	146	612
	Oct 21 to 25	885	198	340	186	141	181	1,931
	Oct 29 to Nov 1	549	112	148	90	69	66	1,034
	Nov 4 to 8	335	90	62	38	20	21	566
	Nov 12 to 15	136	56	39	46	14	65	356
	Nov 19 to 22	76	20	10	10	5	15	136
	Nov 26 to 29	Ns	Ns	Ns	Ns	Ns	Ns	0
	Dec 2 to 6	0	0	7	0	1	1	9
	Total	2,113	566	726	441	311	495	4,652
% Frequency	45	12	16	9	7	11		
2003	Oct 14 to 17	0	Ns	38	22	19	48	127
	Oct 20 to 24	563	194	228	178	77	150	1,390
	Oct 27 to 31	553	73	103	18	119	99	965
	Nov 4 to 7	310	33	97	61	50	74	625
	Nov 12 to 15	44	43	14	11	15	48	175
	Nov 19 to 22	2	0	4	2	5	7	20
	Total	1,472	343	484	292	285	426	3,302
	% Frequency	45	10	15	9	8	13	

Table 1. (Continued). Weekly summary and percent frequency of mainstem Klamath River fall Chinook salmon redd counts for Reaches 1 to 6, 1993 to 2006 (NS = No Survey, R1 = Iron Gate Dam to Ash Creek, R2 = R1 to Beaver Creek, R3 = R2 to Blue Heron, R4 = R 3 to Seiad Bar, R5 = R4 to China Point, R6 = R5 to Indian Creek).

Year	Week	Reach						Total
		R1	R2	R3	R4	R5	R6	
2004	Oct 11 to 15	Ns	0	6	1	3	0	10
	Oct 18 to 22	Ns	57	45	27	17	11	157
	Oct 25 to 29	Ns	22	37	9	17	25	110
	Nov 1 to 5	513	36	27	14	7	10	607
	Nov 8 to 12	Ns	2	10	4	4	3	23
	Nov 29 to Dec 3	Ns	0	9	0	0	0	9
	Total	513	117	134	55	48	49	916
% Frequency	56	13	15	6	5	5		
2005	Oct 18 to 20	Ns	12	14	3	3	27	59
	Oct 25 to 27	Ns	10	17	15	17	37	96
	Nov 1 to 3	Ns	9	8	8	7	20	52
	Nov 8 to 10	Ns	Ns	Ns	Ns	Ns	Ns	0
	Nov 15 to 17	Ns	8	1	20	1	31	61
	Total	0	39	40	46	28	115	268
% Frequency	0	15	15	17	10	43		
2006	Oct 16 to 20	109	21	41	66	31	155	423
	Oct 23 to 27	167	17	30	61	21	55	351
	Oct 30 to Nov 3	96	10	33	12	Ns	6	157
	Nov 6 to 10	66	3	9	7	19	110	214
	Nov 13 to 15	15	6	4	Ns	Ns	Ns	25
	Nov 20 to 24	Ns	Ns	Ns	Ns	Ns	Ns	0
	Nov 29	Ns	Ns	Ns	Ns	Ns	16	16
	Total	453	57	117	146	71	342	1,186
% Frequency	38	5	10	12	6	29		

Table 2. Fall Chinook salmon redds per river kilometer (rkm) for 10 rkm river kilometer (approximate) sections on the mainstem Klamath River, 1993 to 2006 ("Ns" = No survey).

Tributary Reach	Reach Length (rkm)	Year													
		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Iron Gate Dam (rkm 309.75) to Cape Horn Creek (300.6)	9.2	8.7	69.9	137.8	61.0	85.0	84.7	65.4	64.2	61.0	161.4	106.8	43.7	Ns	43.2
Cape Horn Creek (300.59) to Shasta River (288.45)	12.2	0.6	14.9	41.3	12.0	20.2	18.7	9.5	16.1	22.0	51.4	40.0	8.9	Ns	4.6
Shasta River (288.44) to Humbug Creek (279.7)	8.8	1.0	1.8	7.2	1.3	2.2	4.8	3.8	10.5	8.9	18.1	11.6	5.9	1.8	1.8
Humbug Creek (279.69) to Vesa Creek (268.3)	11.4	1.6	3.0	3.2	1.3	2.8	1.9	2.5	4.8	5.6	15.4	10.8	2.9	0.8	1.6
Vesa Creek (268.29) to Little Humbug Creek (257.45)	10.9	1.7	10.5	15.4	6.1	5.3	3.9	2.7	10.9	20.5	33.0	19.4	5.7	1.6	3.2
Little Humbug Creek (257.44) to Kohl Creek (248.0)	9.5	2.7	6.1	16.8	4.7	7.9	4.5	0.9	8.4	16.4	28.7	20.8	6.9	2.4	5.5
Kohl Creek (247.99) to Kinsman Creek (237.05)	11.0	2.4	4.0	14.5	5.3	3.6	5.5	3.0	5.2	13.2	22.6	14.2	3.2	1.0	4.0
Kinsman Creek (237.04) to Kuntz Creek (227.3)	9.8	0.8	6.8	3.9	3.4	1.6	0.6	1.2	3.4	9.3	20.1	10.2	1.4	1.2	1.9
Kuntz Creek (227.29) to Walker Creek (217.0)	10.3	2.0	8.8	12.0	2.3	14.6	3.5	1.8	10.5	15.0	29.8	21.7	4.1	2.8	10.6
Walker Creek (216.99) to Portuguese Creek (207.65)	9.4	2.7	9.0	13.4	8.0	1.9	1.4	2.2	4.1	8.1	12.1	10.7	2.6	1.9	3.8
Portuguese Creek (207.64) to Shinar Creek (199.1)	8.6	0.5	4.1	8.1	5.0	2.9	2.3	1.9	2.4	5.8	19.0	18.0	2.7	0.7	3.0
Shinar Creek (199.09) to China Creek (191.95)	7.2	3.1	10.6	19.9	11.4	4.3	0.8	0.4	0.8	4.3	9.4	7.8	0.8	1.9	8.3
China Creek (191.94) to Ottley Gulch (183.7)	8.3	4.9	14.0	23.4	17.7	13.6	8.1	4.3	14.3	25.9	27.8	27.8	3.1	10.1	17.3
Ottley Gulch (183.69) to Indian Creek (173.85)	9.9	2.4	9.1	18.9	6.7	13.4	4.9	3.1	6.2	6.4	24.5	17.8	2.2	2.9	17.6

Table 3 Natural fall Chinook salmon spawning escapement adult and grilse expansion, Klamath River, 2006 (CDFG 2007).

Natural Spawning Area	Natural Spawners		Totals
	Grilse	Adults	
Mainstem Klamath River Iron Gate Dam to Indian Creek	853	4,538	5,391
Bogus Creek Basin	765	3,368	4,133
Shasta River Basin	1,395	789	2,184
Scott River Basin	1,953	3,007	4,960
Salmon River Basin	791	1,278	2,069
Misc. Klamath Tributaries upstream of Yurok Reservation	739	1,165	1,904
Yurok Reservation Tributaries	20	119	139
Total Natural Spawners	6,516	14,264	20,780

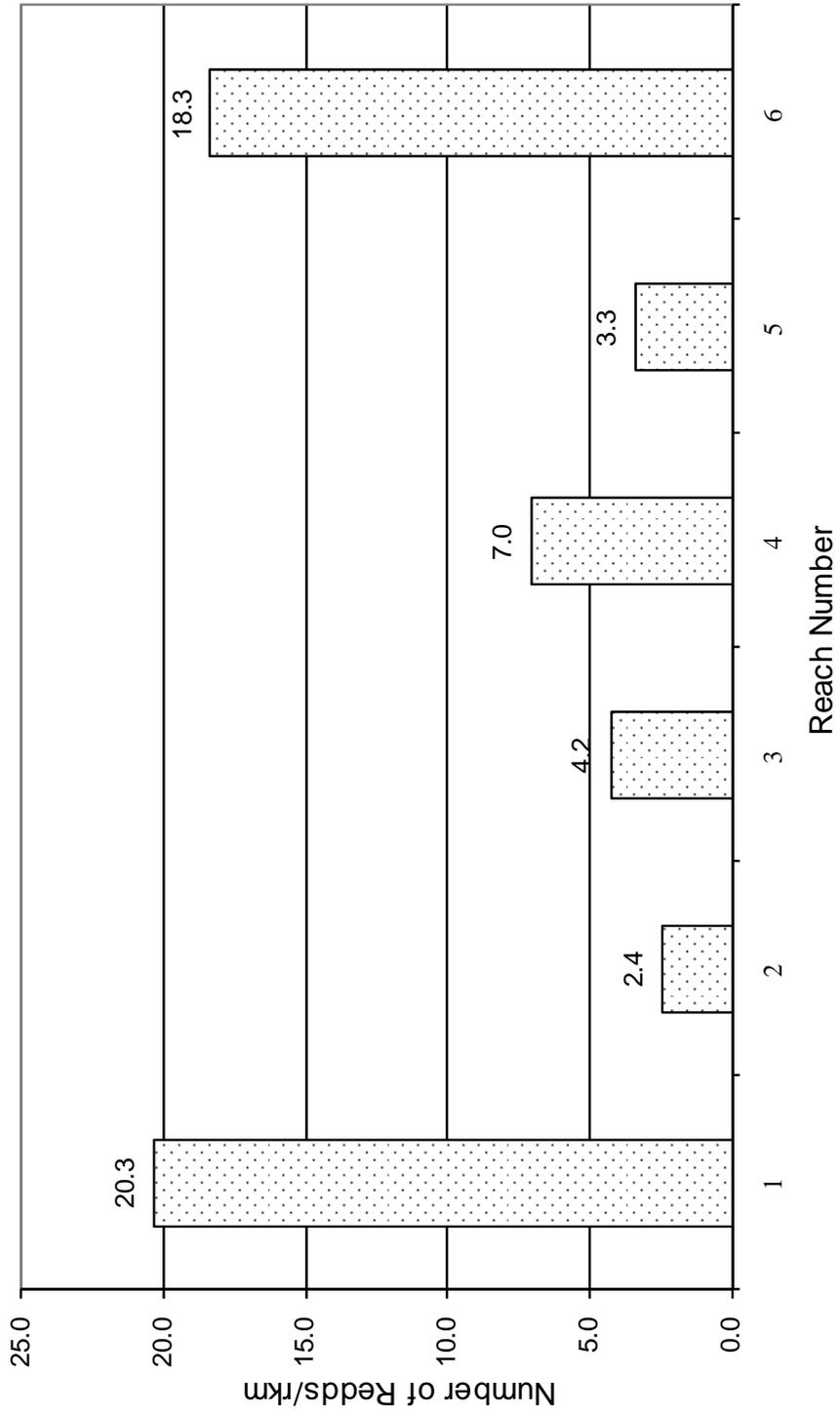


Figure 3. Mainstem Klamath River fall Chinook salmon redd density (redds/rkm) by reach, 2006.

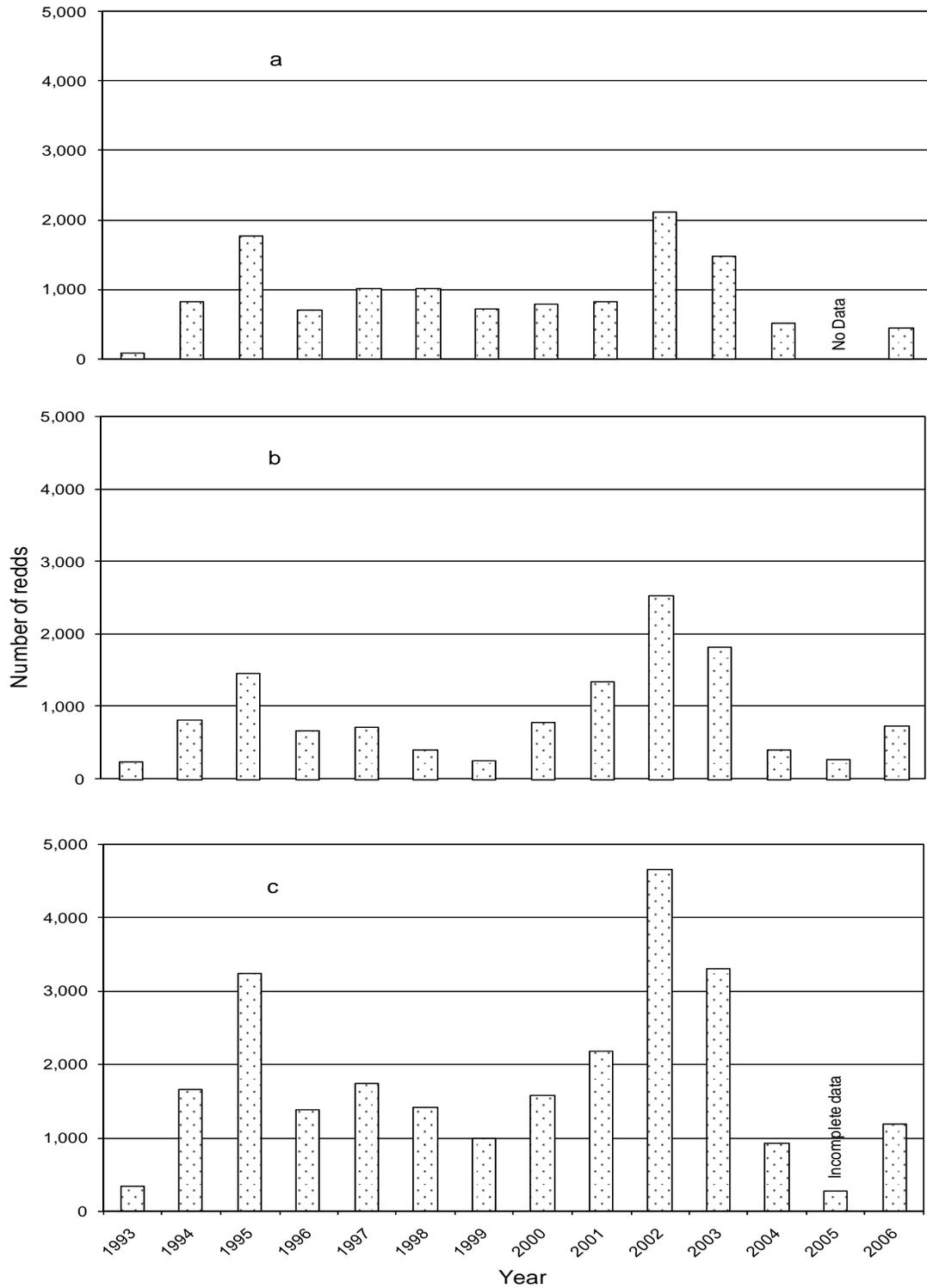


Figure 4. USFWS Chinook salmon redd counts 1993 to 2006 for a) Reach 1; b) Reaches 2 to 6, and c) all reaches combined.

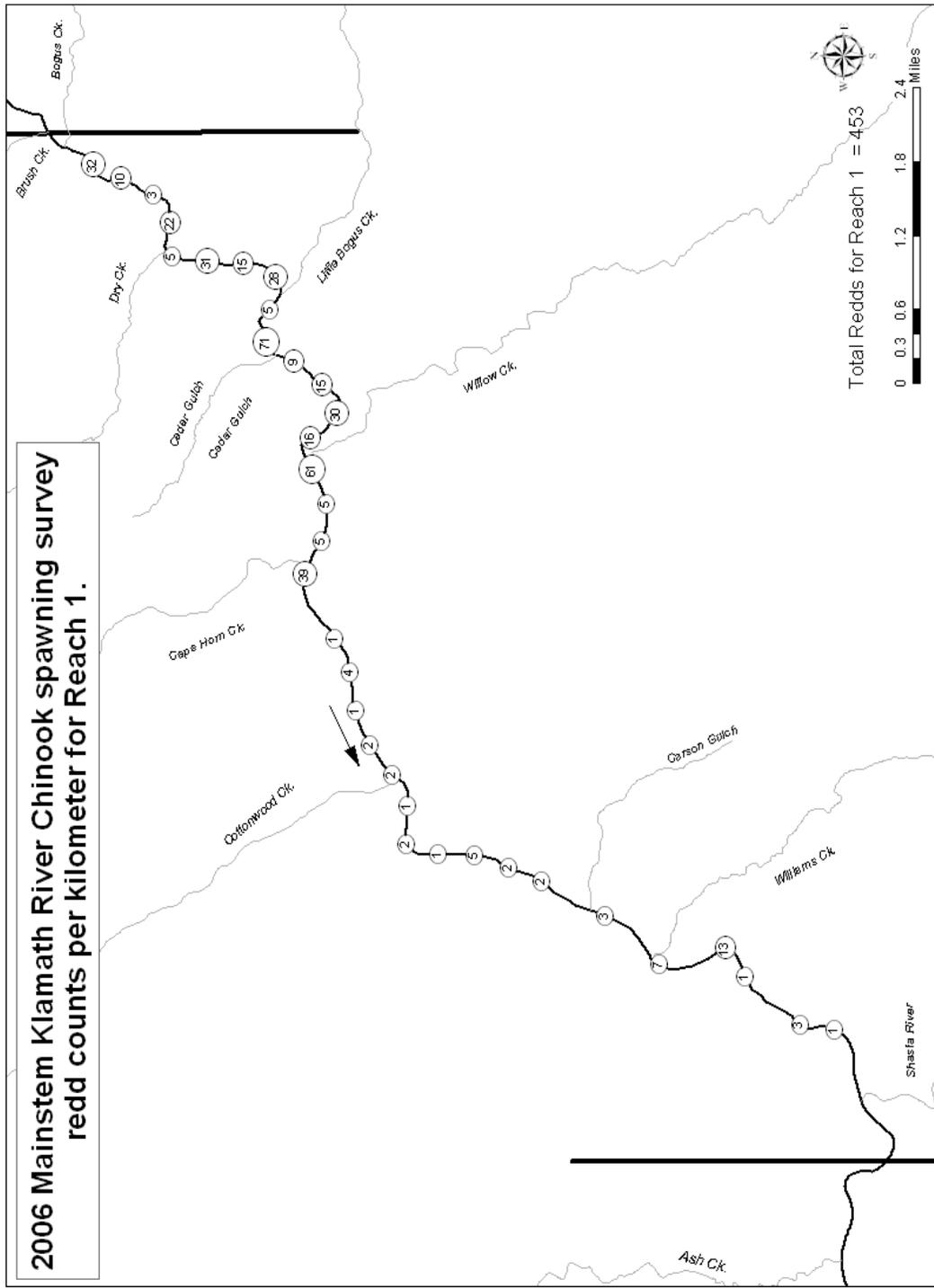


Figure 5. Redd distribution map for 2006, mainstem Klamath River, Iron Gate Dam to Deliverance Camp.

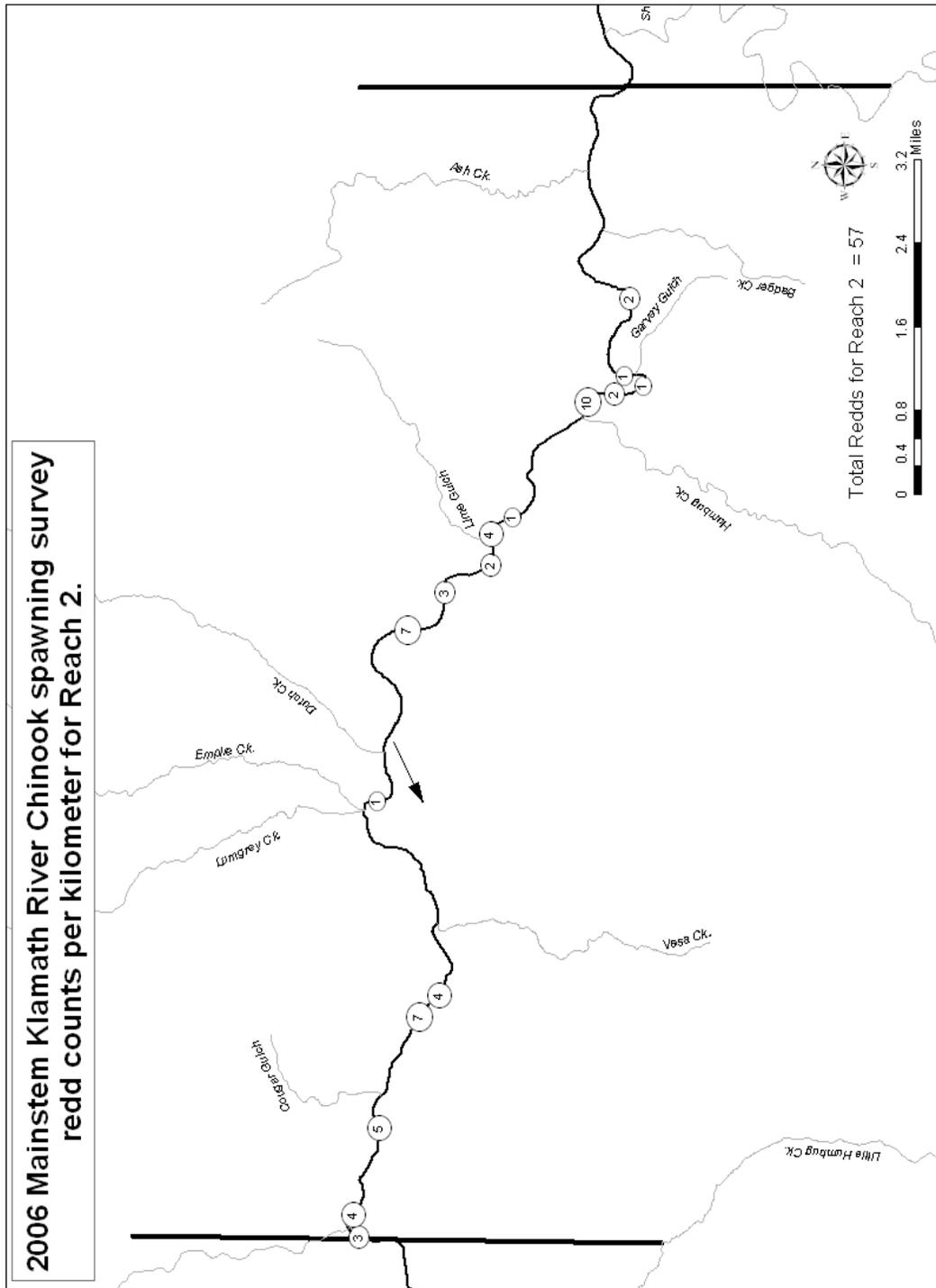


Figure 6. Redd distribution map for 2006, mainstem Klamath River, Ash Creek to Beaver Creek.

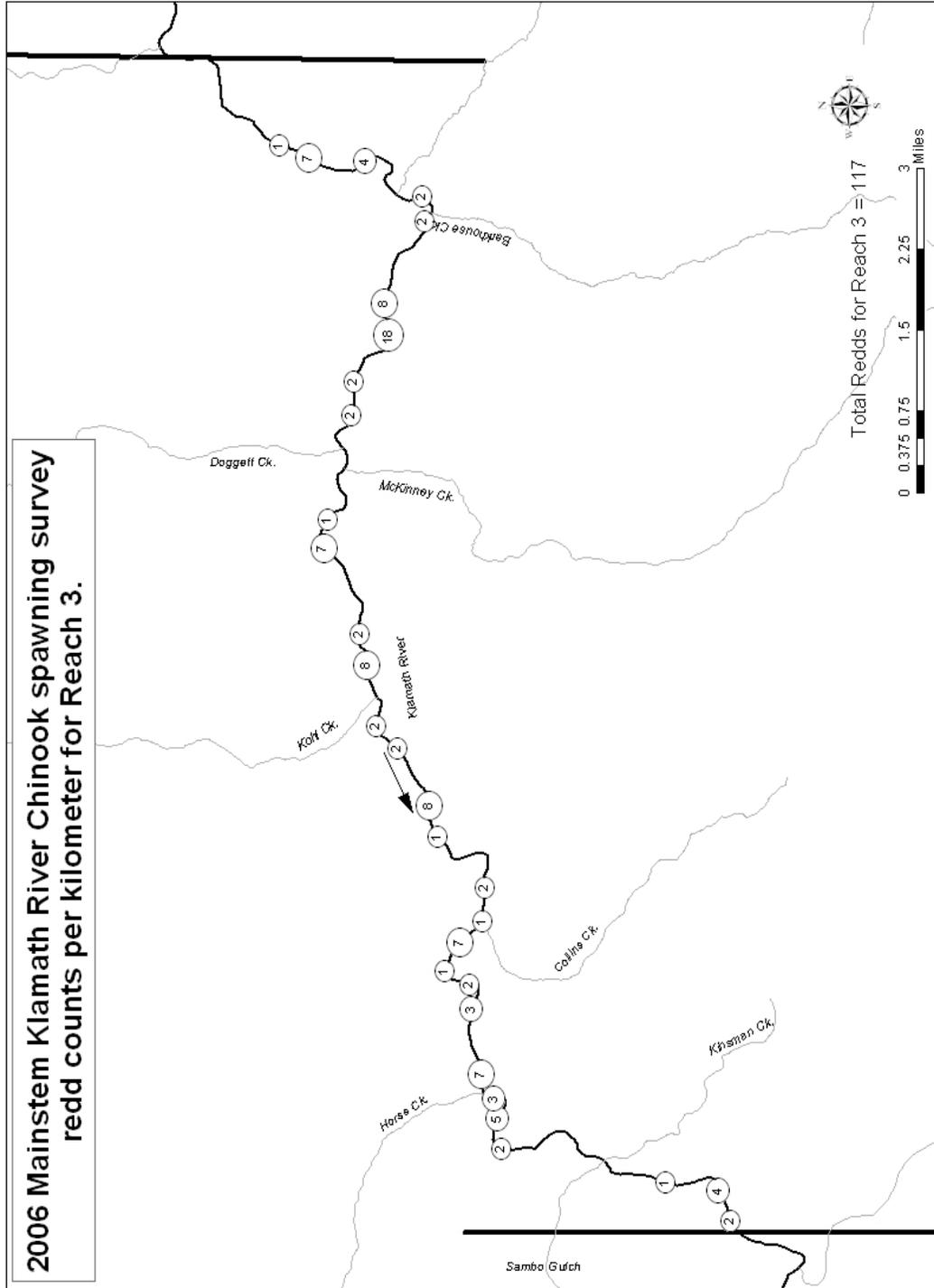


Figure 7. Redd distribution map for 2006, Beaver Creek to Blue Heron.

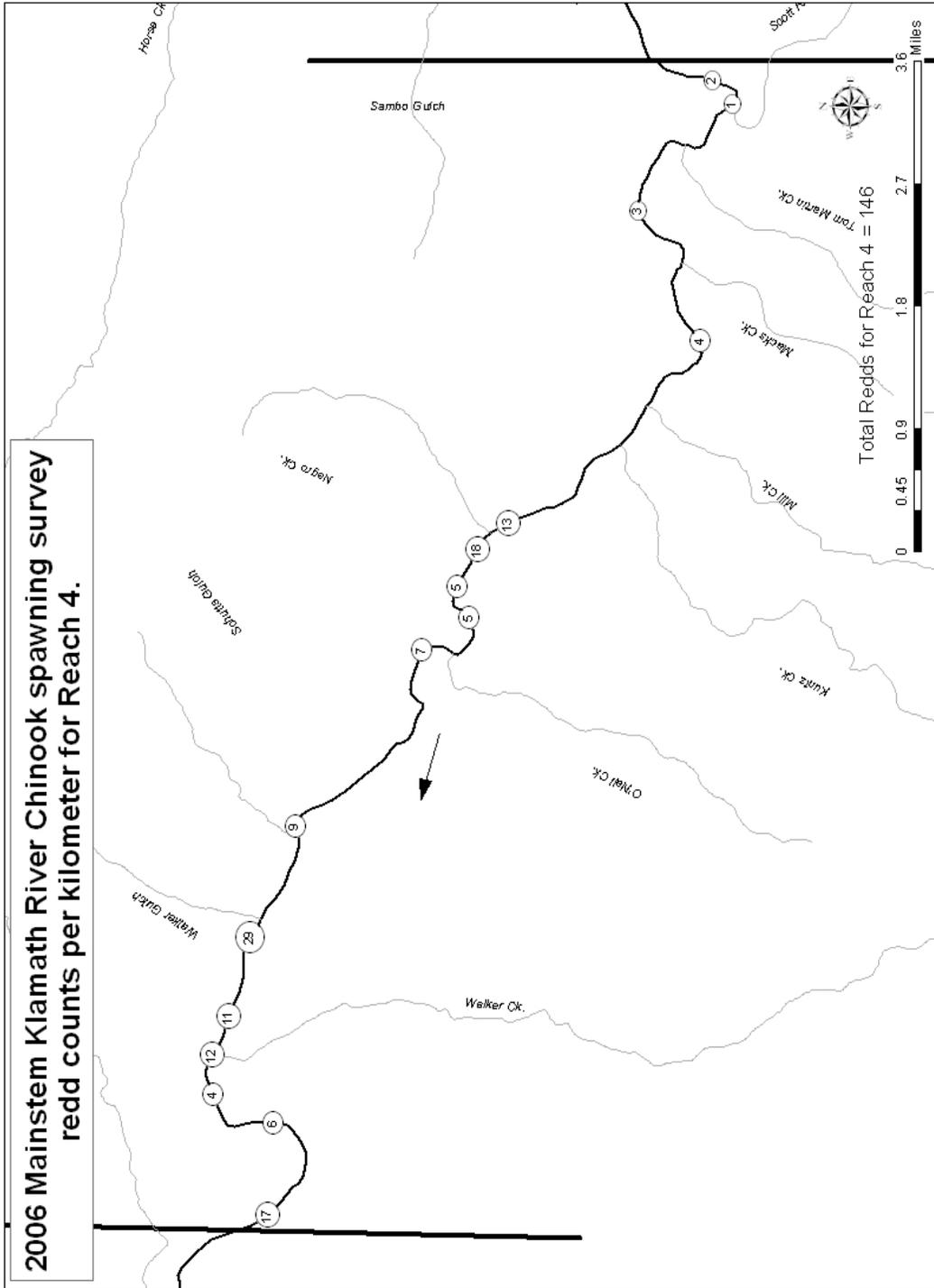


Figure 8. Redd distribution map for 2006, mainstem Klamath River, Blue Heron to Seiad Bar.

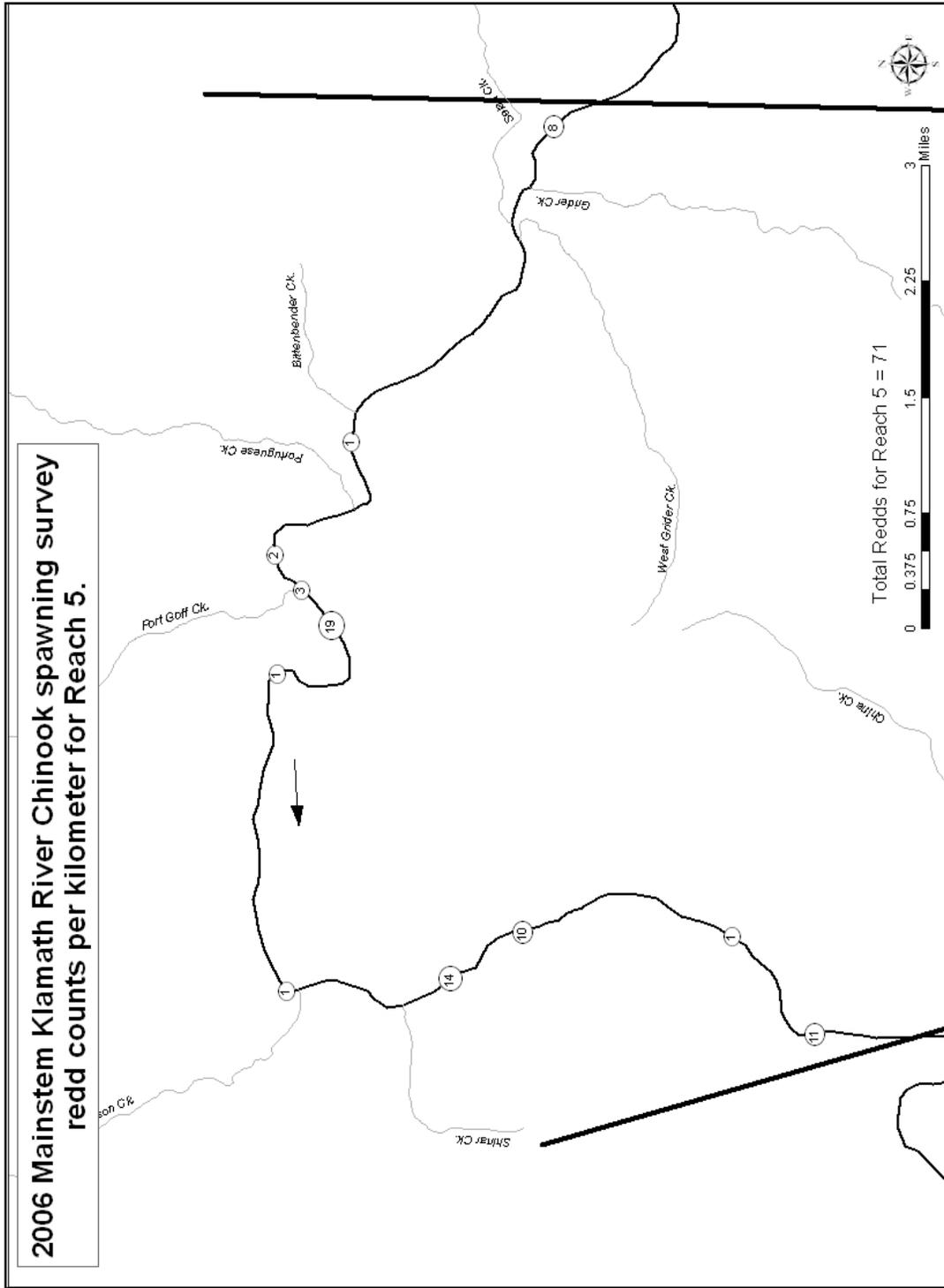


Figure 9. Redd distribution map for 2006, mainstem Klamath River, Seiad Bar to China Point.

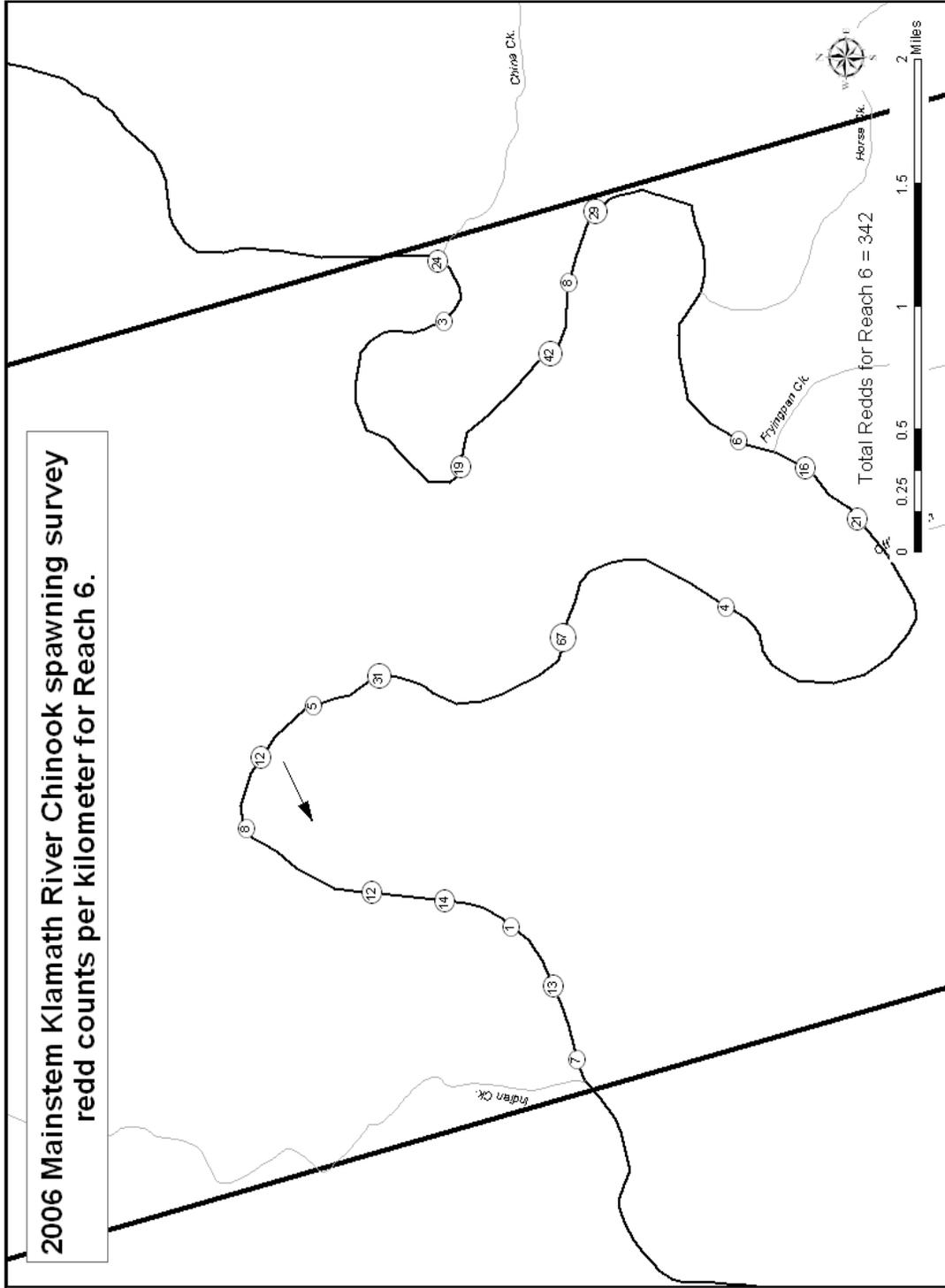


Figure 10. Redd distribution map for 2006, mainstem Klamath River, China Point to Indian Creek.

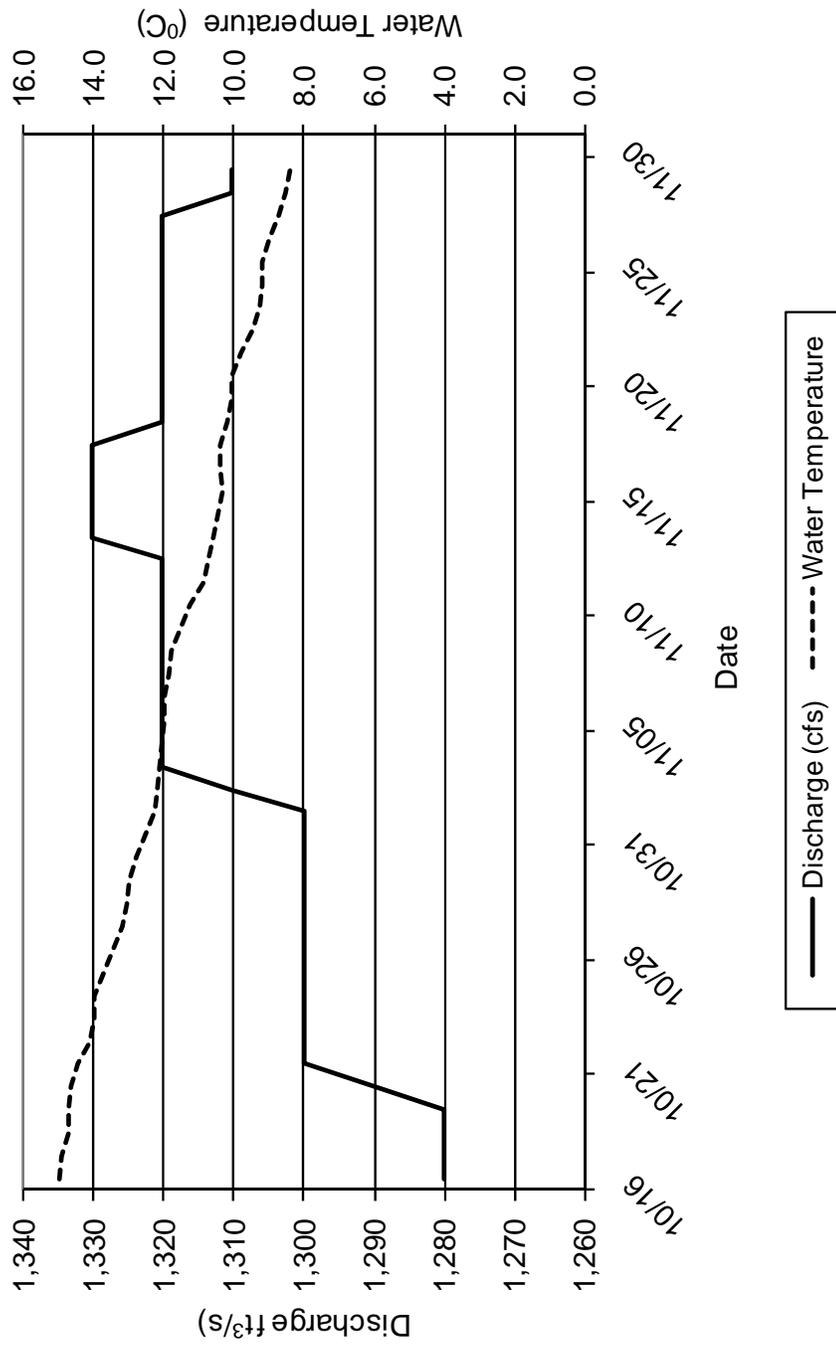


Figure 11. Water temperatures (°C) at river kilometer 309.8 and discharge (ft³/s) from Iron Gate Dam (October 16 to November 29, 2006).

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Literature Cited

- CDFG (California Department of Fish and Game). 2007. Klamath River basin fall Chinook salmon spawner escapement, in-river harvest and run-size estimates, 1978-2006. Available from W. Sinnen, CDFG, 5341 Ericson Way, Arcata, CA 95521.
- Harvey, B.C. and T.E. Lisle. 1999. Scour of Chinook salmon Redds on Suction Dredge Tailings. *North American Journal of Fisheries Management* 19:613-617.
- KRTAT (Klamath River Technical Advisory Team). 2007. Klamath River fall Chinook age-specific escapement, river harvest, and run size estimates, 2006 run. Available from the Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, OR 97220-1348.
- Leidy, R.A. and G.R. Leidy. 1984. Life stage periodicities of anadromous salmonids in the Klamath River Basin, northwestern California. U.S. Fish and Wildlife Service, Division of Ecological Services, Sacramento, CA. 21 pp.
- PFMC (Pacific Fishery Management Council). 1988. Review of 1988 ocean salmon Fisheries. Portland, Oregon.
- USFWS 1991. Annual Report: Klamath River Fisheries Assessment Program, 1989. Coastal California Fishery Resource Office, Arcata, CA.