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Mainstem Klamath River Fall Chinook Salmon Spawning Survey 2004

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Abstract Results of the twelfth 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 for six weeks (October 11 to December 3, 2004), covering 135.9 river kilometers (rkm; 84.4 river miles) between Iron Gate Dam and the confluence of Indian Creek at Happy Camp. A total of 916 redds were observed during the 2004 survey, which was 2.2 times lower than annual average from the preceding eleven years ($\bar{x}$ = 2,010 redds). The 2004 count represents a 72% decrease from the 2003 count and the second lowest (n = 330) number since 1993. The highest redd density in 10 km river sections was between Iron Gate Dam and Cape Horn Creek (43.7 redds/rkm). The lowest redd density was between Shinar and China Creek (0.8 redds/rkm). Water clarity between Iron Gate Dam and Indian Creek ranged from 2.5 to 3.0 m, and was similar to most survey years. In represented some of the most stable visibility recorded since the initiation of these surveys. During 2004, one redd was observed on suction dredge tailings between Iron Gate Dam and Indian Creek.

Introduction

The Klamath River drains approximately 14,000 km^2 in Oregon and 26,000 km^2 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 km^2 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 km^2, and the Shasta, Scott and Salmon rivers, each draining about 2,070 km^2. Iron Gate Dam (IGD), located at river kilometer (rkm) 310.3 on the Klamath River and Lewiston Dam located at rkm 249 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, were constructed to mitigate for losses in natural fish production that resulted from dam construction (USFWS 1991).

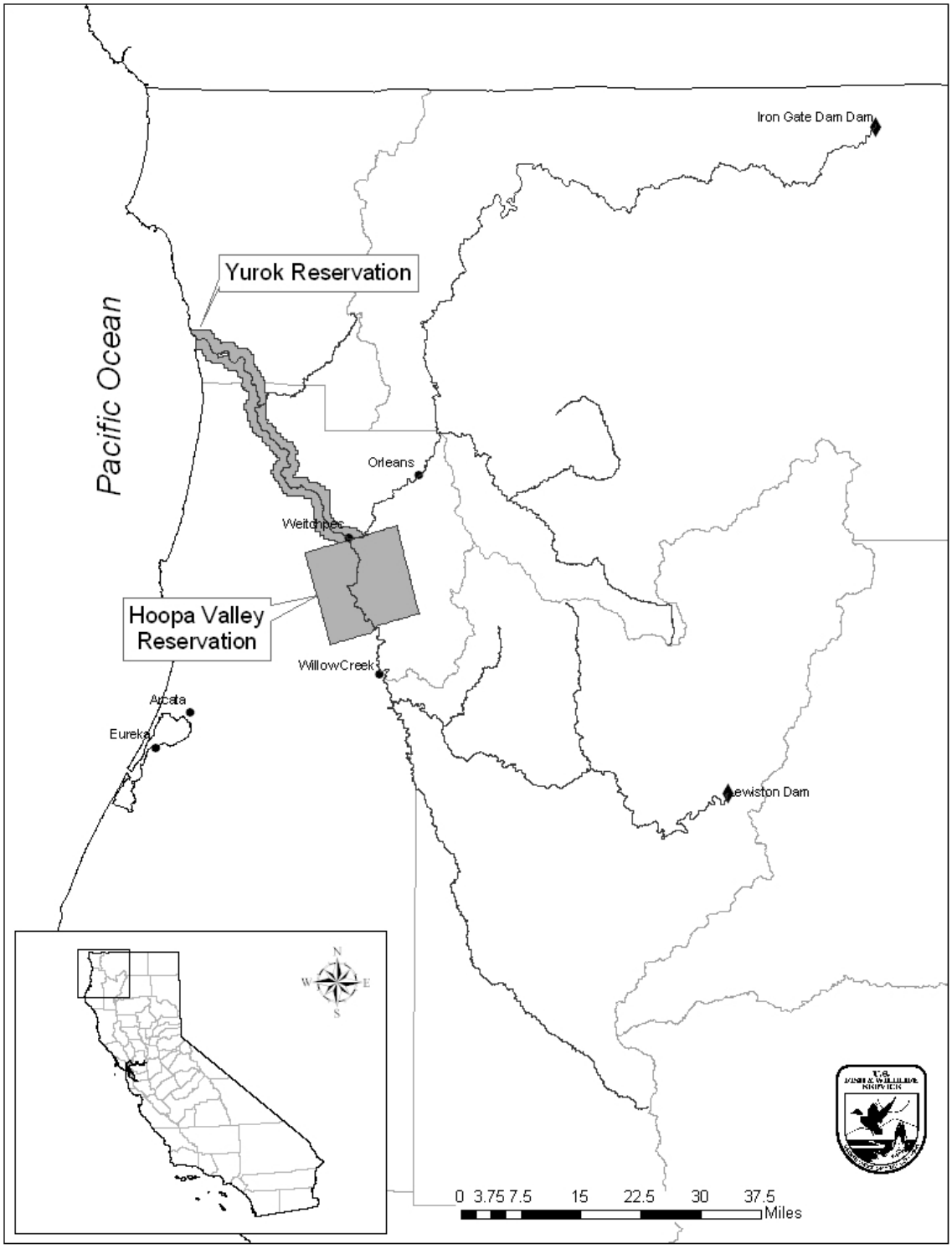

Figure 1. Overview map of the Klamath River Basin accessible to fall Chinook salmon.

The Klamath River Basin historically supported large runs of Chinook *Oncorhynchus tshawytcha* and 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 historically providing the mainstay of the Indian economy in the area. Sport fishing for salmon and steelhead in the drainage may exceed 200,000 angler days annually. 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 have been 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 (USFWS 1991). The US Fish and Wildlife Service (USFWS) was funded through the Klamath River Basin Conservation Area Restoration Program to identify fall Chinook salmon spawning areas and collect information necessary to estimate the natural fall Chinook salmon spawning escapement on the mainstem Klamath River between IGD and the confluence of Indian Creek (rkm 173.8). This information is critical for monitoring long-term trends in escapement and for developing harvest management alternatives.

Materials and Methods

Survey Procedures

The Arcata Fish and Wildlife Office (AFWO) mainstem Klamath River redd survey protocol consisted of six mainstem reaches (Figure 2) covering 135.9 rkm (84.4 river miles). In 2004, the lower five reaches (Ash Creek to Indian Creek) were surveyed over an eight-week period (October 11 to December 3). No survey was conducted during the sixth (November 15 to 19) and seventh (November 22 to 26) week due to high flows that limited visibility. The uppermost reach (Reach 1; IGD to Deliverance Camp) was surveyed just once (November 2) during 2004. Two individual crews conducted the surveys. Each crew covered the same survey reaches each week to remain familiar with spawning areas and prior redd locations.

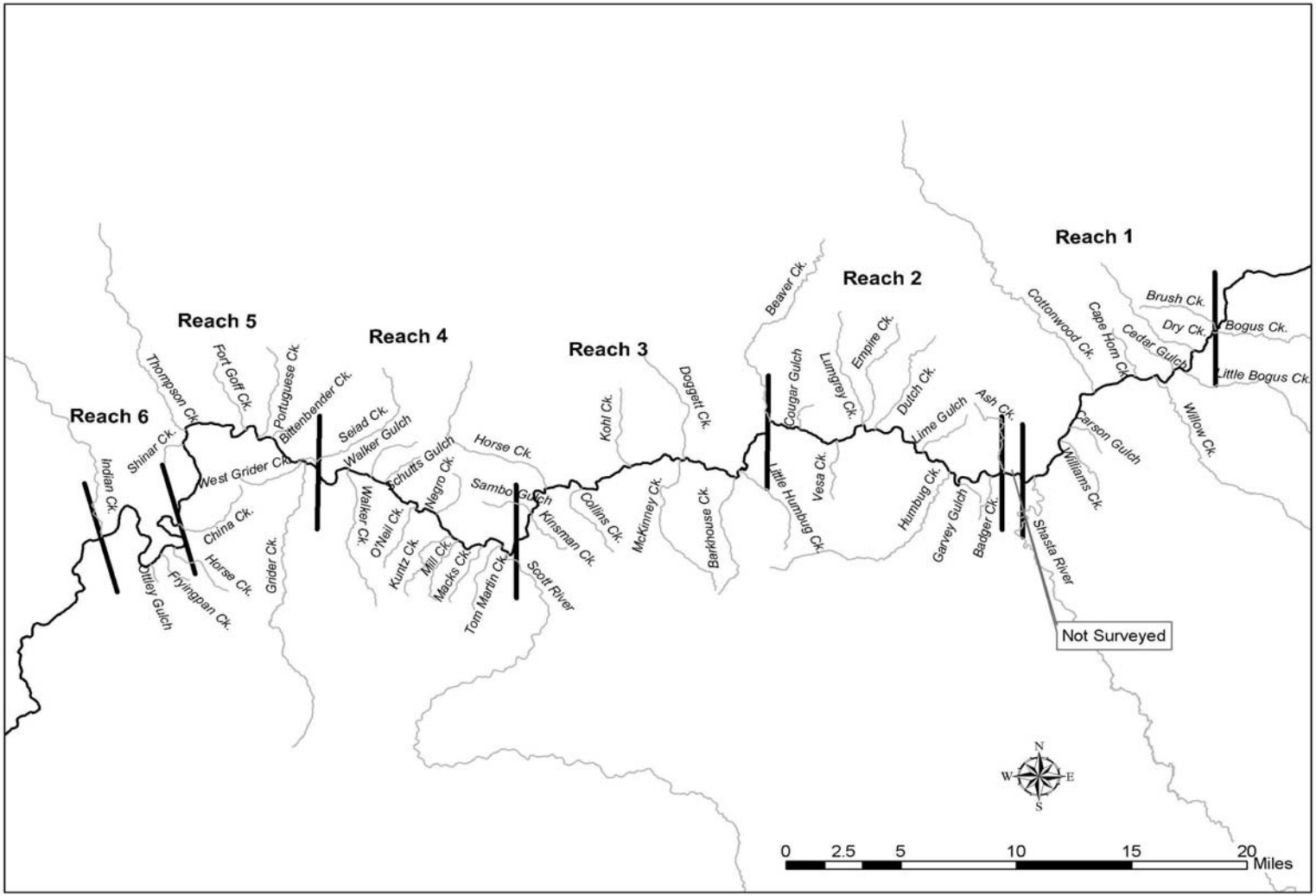

Figure 2. Mainstem Klamath River Chinook salmon spawning survey project location including individual study reaches (1 to 6).

Rafting Equipment

Two 4.3 m (14 foot) inflatable Wing Catarafts were used for direct observation of fall Chinook salmon redds. These rafts are commonly used in whitewater rescue due to their stability and maneuverability in fast water. Rafts were stacked on a flat bed trailer and deployed at selected access sites along the study area. Each raft was equipped with a rowing frame, a modified observation platform, and anchoring system. Two personnel operated each raft (rower and observer).

Individual Reaches

Reach 1: IGD river access (rkm 309.8) to Deliverance Camp river access (rkm 287.5). Reach 1 is approximately 22.3 rkm (13.8 miles) in length (Figure 2). Due to the high percentage of redds in Reach 1, two cataraft crews surveyed the entire reach from IGD to Deliverance Camp river access. One crew surveyed the south bank to mid-channel while the second crew surveyed from the north bank to mid-channel. This reach was completed by two crews in 7 hours. This was the first year since 1993 that this reach was surveyed just once. Mark recapture carcass estimators are now used to derive the number of natural fall Chinook salmon that spawn within Reach 1. The section of river between Deliverance Camp river access and Ash Creek river access was not surveyed because past surveys revealed a lack of available spawning habitat in this area.

Reach 2: Ash Creek river access (rkm 285.7) to Beaver Creek riffle river access (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 riffle river access is located along the north bank on a large gravel bar downstream from Beaver Creek Bridge, just off Highway 96. One crew surveyed this reach on the first survey day (Wednesday) of each week in about 7 hrs, depending on flows.

Reach 3: Beaver Creek riffle river access to Blue Heron river access (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 just off Highway 96. This reach was surveyed by one crew on the first survey day (Wednesday) of each week, taking about 8 hrs to complete.

Reach 4: Blue Heron river access to Seiad Bar river access (rkm 213.6). Reach 4 is approximately 20.8 rkm (12.9 miles) in length (Figure 2). The Seiad Bar river access is located along the north bank of the Klamath River on Wally Johnson's property. Access to the river is reached by taking Diamond J road and turning right on an unmarked road located near the California Department of Transportation compound. Reach boundaries remained the same as in previous years. This reach was surveyed on the second day (Thursday) of each survey week by one crew, taking an average of about 8 hrs to complete.

Reach 5: Seiad Bar river access to China Point river access (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) site just off Highway 96. One crew surveyed this reach on the fourth day (Thursday) of each survey week, taking about 7 hrs to complete.

Reach 6: China Point river access to the Indian Creek confluence (rkm 173.8). Reach 6 is approximately 18.6 rkm (11.6 miles) in length (Figure 2). Due to the high concentration of redds in this area, this reach was split at Gordons Ferry river access (rkm 185). China Point river access to Gordons Ferry river access is about 7.4 rkm (4.6 miles). Gordons Ferry river access to Indian Creek confluence is about 11.3 rkm (7 miles). The Gordons Ferry river access is located just off Highway 96. This reach was split into two sections and covered by two crews on the fifth day (Friday) of each survey week, with each section taking approximately 5 hrs to complete.

Redd Densities

The mainstem Klamath River between IGD and the confluence of Indian Creek was segregated into fourteen approximately 10-rkm long sections to describe longitudinal patterns in redd abundance within the survey reach.

Collection of Redd Data

A length of plastic 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 also recorded on river maps and on data forms. River reach, flag location, GPS mark number, 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. Fresh redds with bright substrate, little or no periphyton, and well-developed mounds were classified as Redd Age Code 1. Redds two to four weeks old with slightly flattened mounds and dulled substrate due to periphyton growth were classified as Redd Age Code 2. Redds older than four weeks, identifiable only by the presence of a pit and/or mound, were classified as Redd Age Code 3. 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 m^2) redds were not counted, but were noted on data forms.

Water Temperature

Water temperature was recorded using a Data Sonde every half hour throughout the survey period in the mainstem Klamath River just upstream of the Shasta River confluence (rkm 288.5). Hourly data was used to calculate the mean daily water temperatures.

Discharge

Mean daily river flow was obtained from the US Geological Survey gauging station (Number 11516530; Latitude 41º 55’ 41”, Longitude 122º26’35” NAD 27; http://waterdata.usgs.gov/ca/nwis/current/?type=flow), located in the Klamath River just downstream of IGD. Mean daily river flow was recorded in ft^3/s.

Water Clarity

Water clarity was measured each survey week 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. The disc was then raised until the pattern became visible, and this depth was recorded in meters.

Adult Grilse Expansion

The total number of redds counted by AFWO during these surveys is used by CDFG to estimate adult and grilse (two year old) spawning abundance (CDFG 2005). Adult numbers were calculated by multiplying the total redd count by two. This estimate assumes there is only one male and female salmon per redd. The adult and grilse age apportionment for Reaches 1 to 6 was derived from length frequency and scale analysis data from the USFWS carcass surveys in Reach 1 (KRTAT 2005).

Results and Discussion

A total of 916 Chinook salmon redds were counted between IGD and the confluence of Indian Creek in 2004, representing a 72 % decrease from the 2003 count of 3,302 (Table 1). The highest number of Chinook salmon redds/rkm is still in Reach 1 (Figure 3). The 2004 Chinook salmon redd numbers were the second lowest recorded since the initiation of these surveys (Figure 4). Based on field maps and notes from the survey, locations of redds for all reaches surveyed are shown in (Figures 5 to 10).

Individual Reaches

Reach 1: IGD to Deliverance Camp river access. A total of 513 redds were observed in this reach during the 2004 survey (Table 1; Figure 5). Since this reach was only sampled during the fourth week (November 1 to 2) of this survey, weekly counts are not available. The 513 redds represent 56 % of the total redd count for 2004. The redd density was 23 redds/rkm (Figure 3). The 513 redds in this reach represent the second lowest since the initiation of these surveys in 1993 (Table 1).

Reach 2: Ash Creek river access to Beaver Creek riffle river access. A total of 117 redds were observed in this reach during the 2004 survey (Table 1; Figure 6). The 117 redds represent 13 % of the total redd count for 2004. Redd density was 4.9 redds/rkm (Figure 3). Peak spawning (n = 57) was observed during the second week (October 18 to 22) of the survey (Table 1). The 117 redds counted in this reach represent the seventh lowest count since the project started in 1993 (Table 1).

Reach 3: Beaver Creek riffle river access to Blue Heron river access. A total of 134 redds were counted in this reach during the 2004 survey (Table 1; Figure 7); comprising 15 % of the total redd count for the season. Redd density was 4.9 redds/rkm (Figure 3). Peak spawning (n = 45) in Reach 3 was observed during the second (October 18 to 22) of the survey (Table 1). The 134 redds observed during the survey is the fourth lowest count for this reach since the project started in 1993 (Table 1).

Table 1. Weekly summary and percent frequency of mainstem Klamath River fall Chinook salmon redd counts for Reaches 1 to 6, 1993 to 2004 (NS = No Survey, R1 = Iron Gate Dam to Ash Creek river access, R2 = R1 to Beaver Creek riffle river access, R3 = R2 to Blue Heron river access, R4 = R3 to Seiad Bar, R5 = R4 to China Point river access, R6 = R5 to Indian Creek river access).

		Reach						
Year	**Week**	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**Total**
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 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	
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	

Table 1. (Continued). Weekly summary and percent frequency of mainstem Klamath River fall Chinook salmon redd counts for Reaches 1 to 6, 1993 to 2004 (NS = No Survey, R1 = Iron Gate Dam to Ash Creek river access, R2 = R1 to Beaver Creek riffle river access, R3 = R2 to Blue Heron river access, R4 = R3 to Seiad Bar, R5 = R4 to China Point river access, R6 = R5 to Indian Creek river access).

		Reach						
Year	**Week**	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**Total**
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 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
	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	
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	

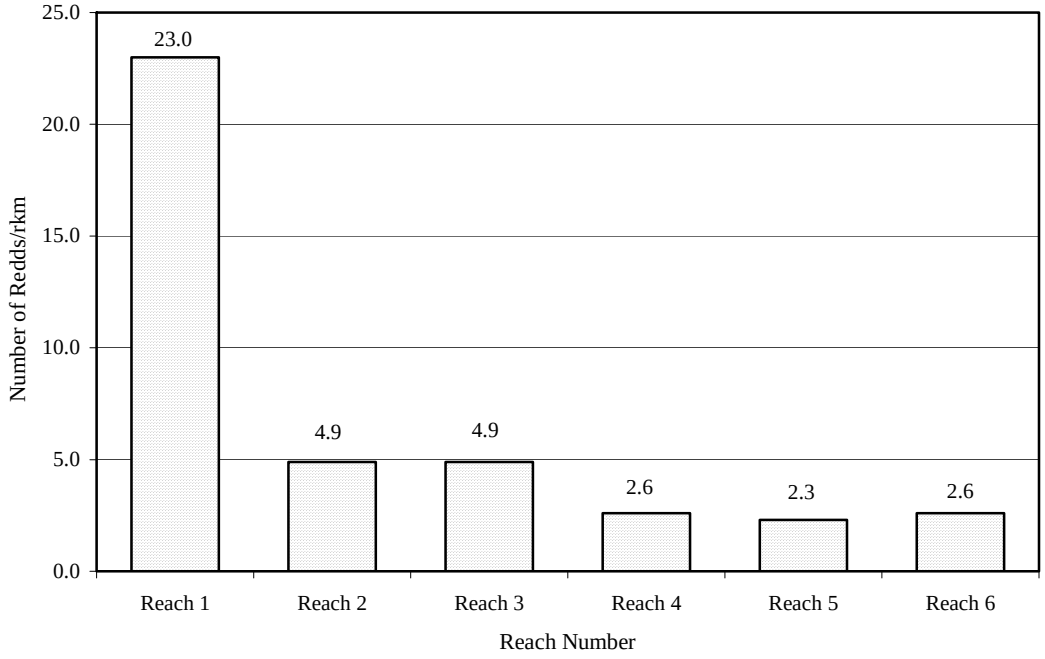

Figure 3. Chinook salmon redd density (redds/rkm) by Reach, 2004.

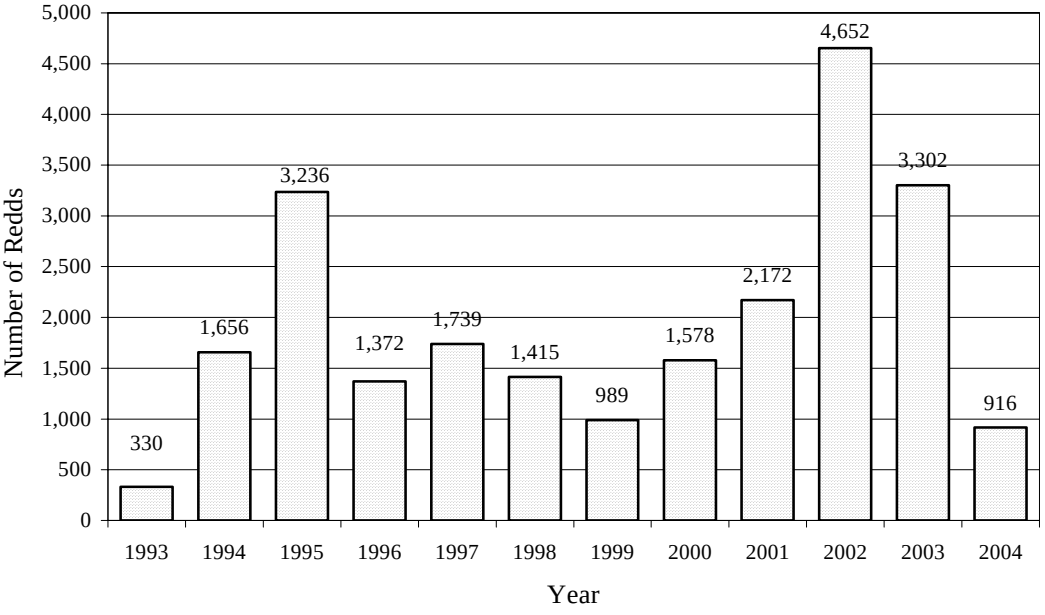

Figure 4. Yearly USFWS Chinook salmon redd counts, 1993 to 2004.

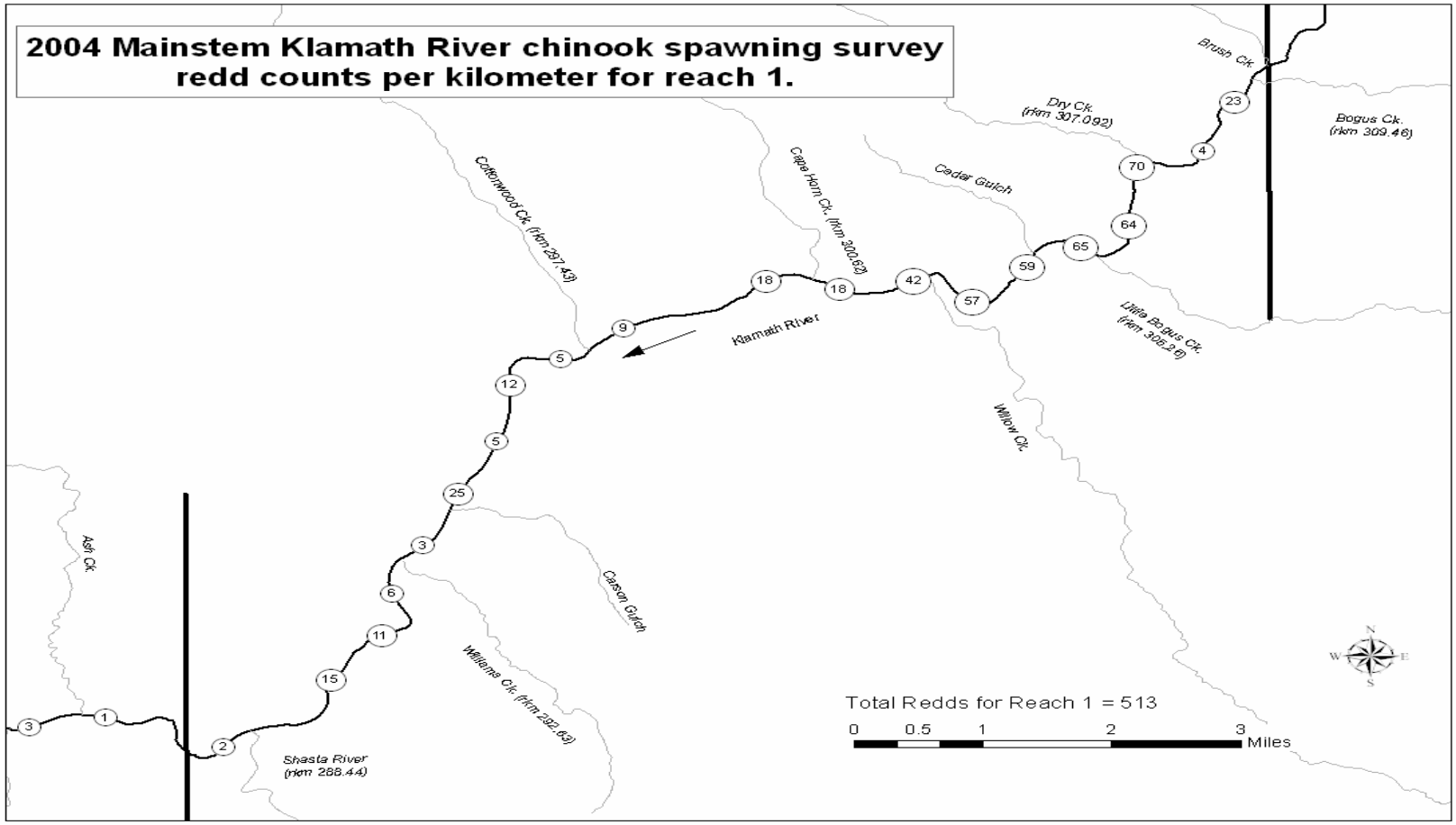

Figure 5. Redd distribution map for 2004, mainstem Klamath River, Iron Gate Dam to Deliverance Camp.

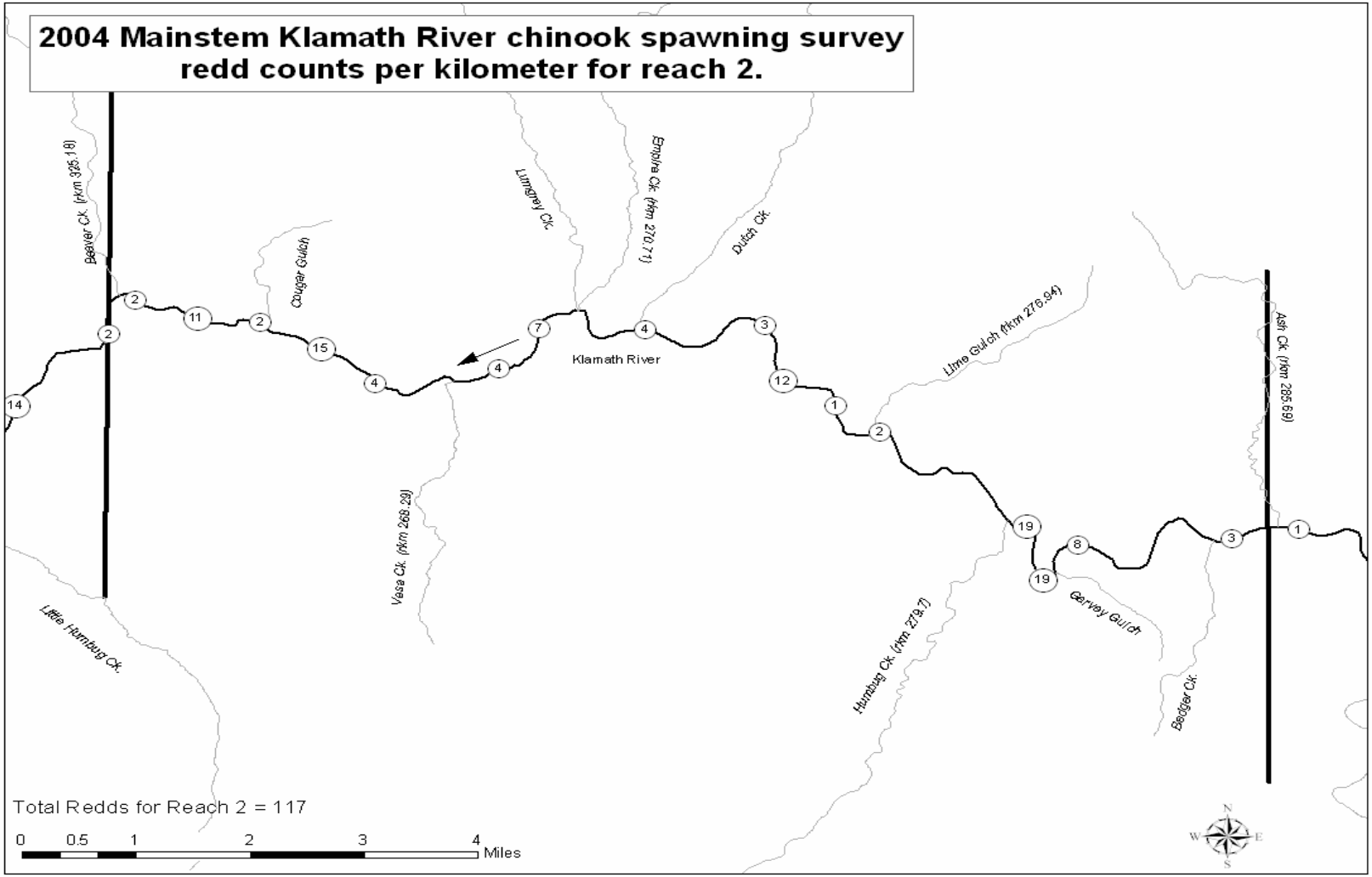

Figure 6. Redd distribution map for 2004, mainstem Klamath River, Ash Creek to Beaver Creek.

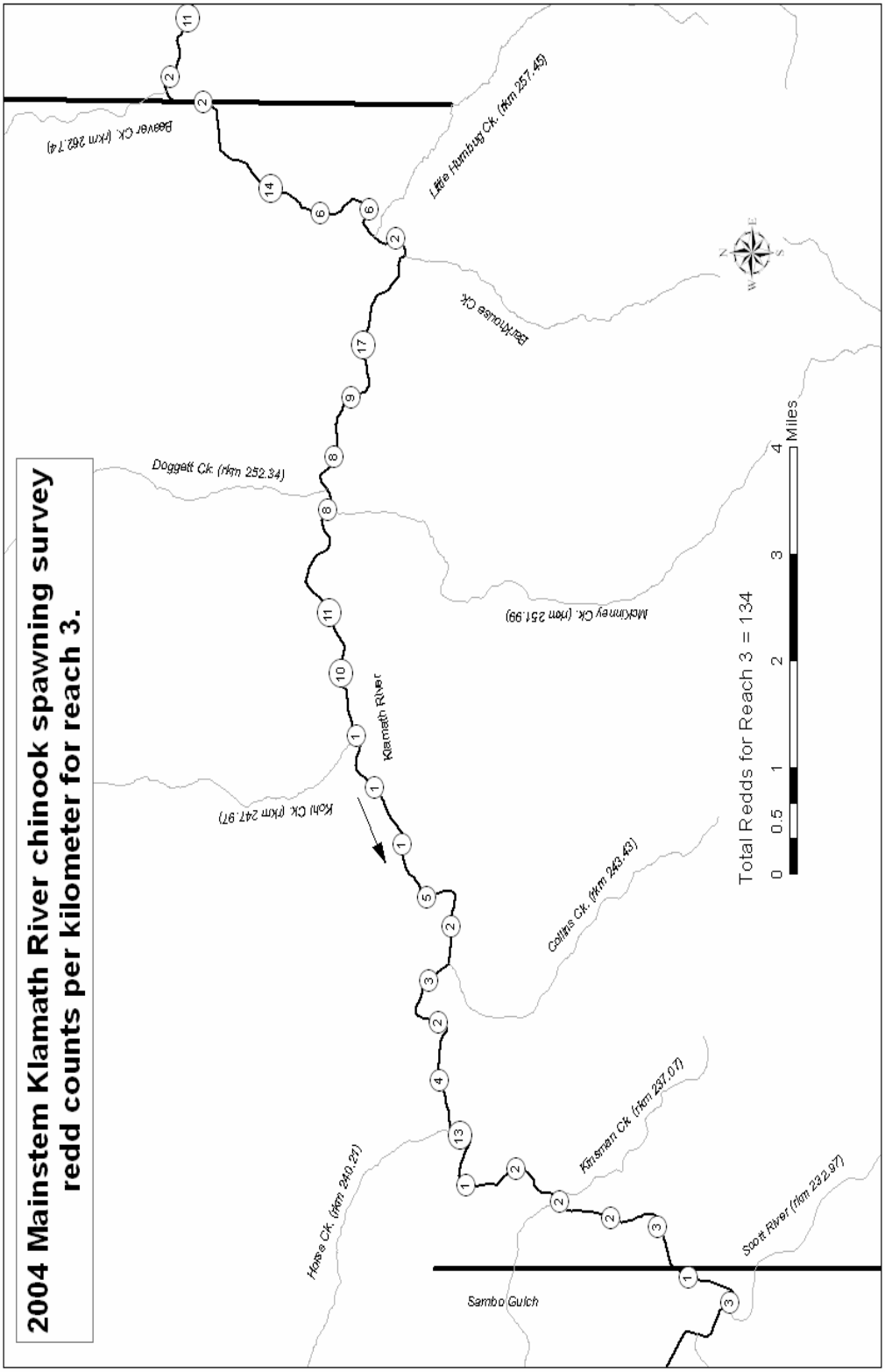

Figure 7. Redd distribution map for 2004, mainstem Klamath River, Beaver Creek to Blue Heron.

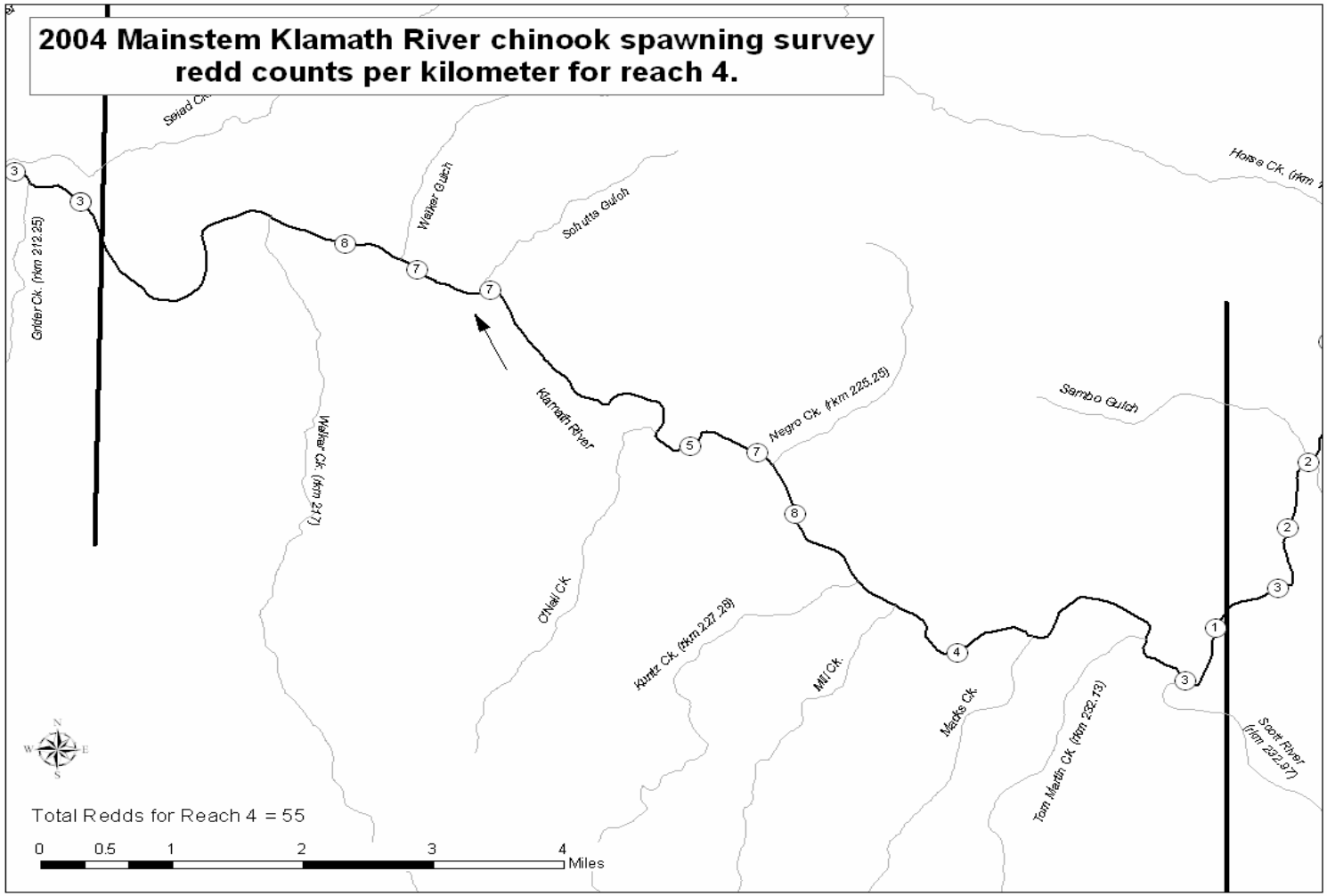

Figure 8. Redd distribution map for 2004, mainstem Klamath River, Blue Heron to Seiad Bar.

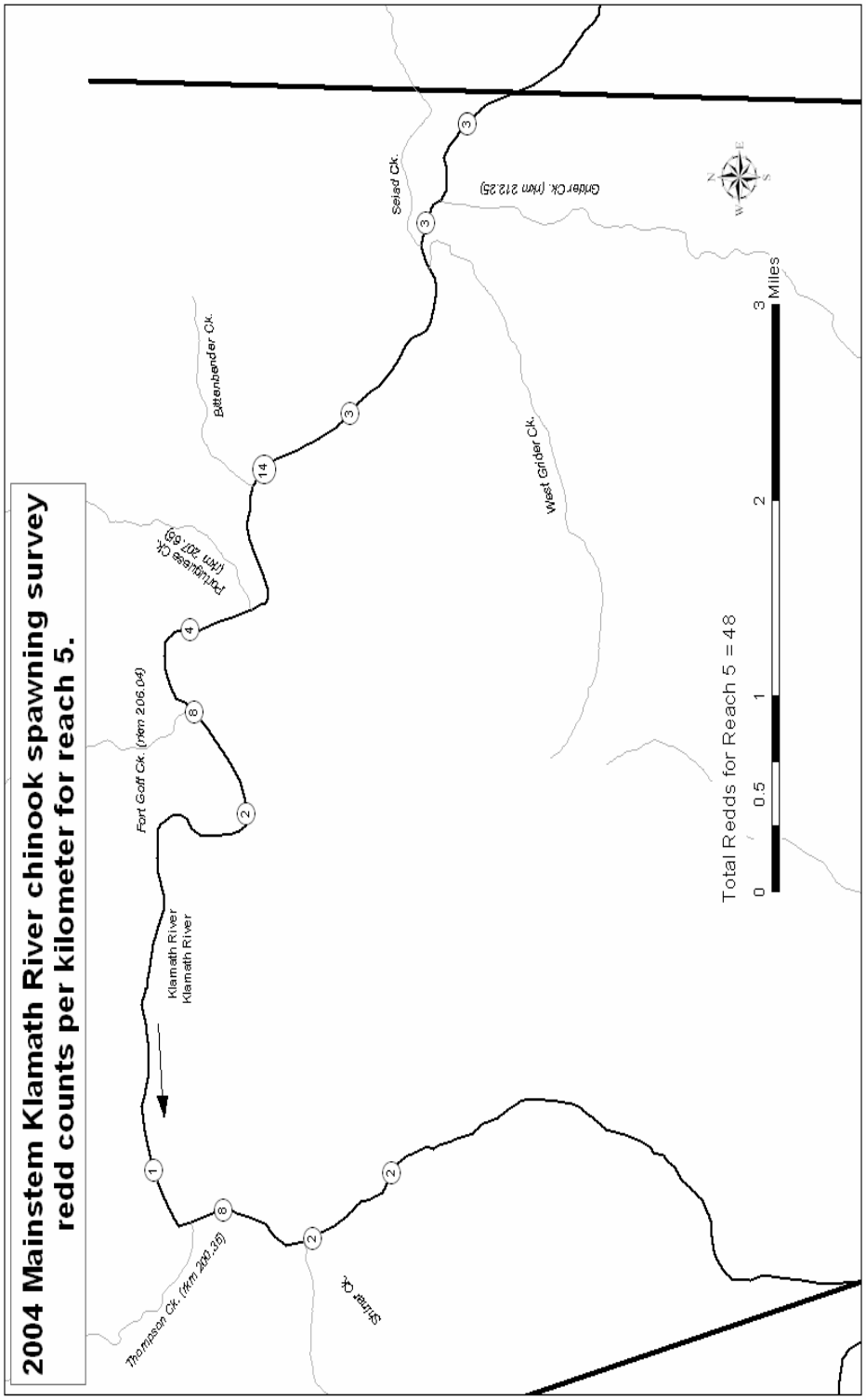

Figure 9. Redd distribution map for 2004, mainstem Klamath River, Seiad Bar to China Point.

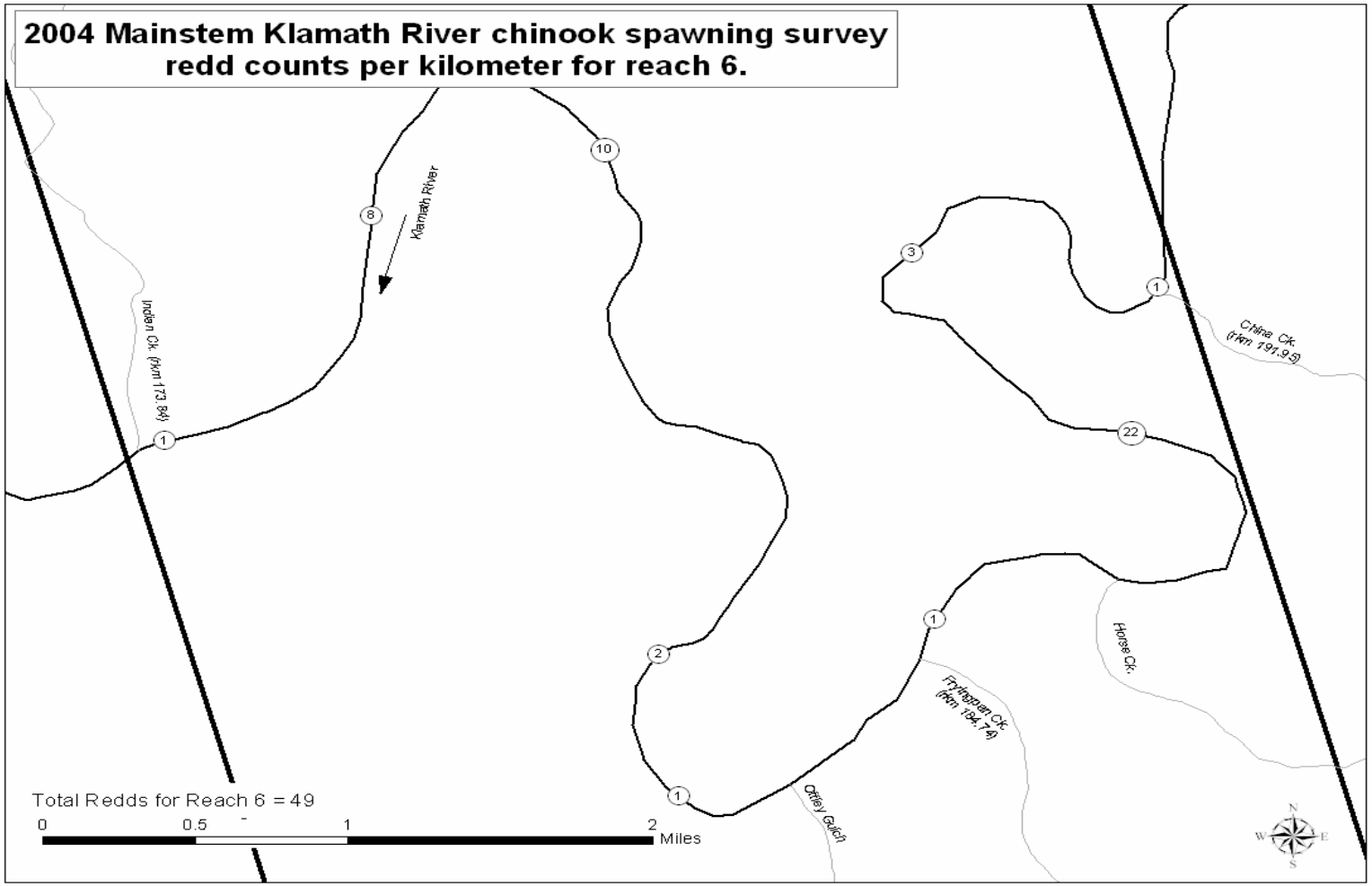

Figure 10. Redd distribution map for 2004, mainstem Klamath River, China Point to Indian Creek.

Reach 4: Blue Heron river access to Seiad Bar river access. A total of 55 redds were counted in Reach 4 during the 2004 survey (Table 1; Figure 8), representing 6 % of the total redd count for the season. Redd density was 2.6 redds/rkm (Figure 3). Peak spawning (n = 27) in Reach 4 occurred during the second week (October 18 to 22) of the survey. The 55 redds observed during the survey is the fifth lowest count for this reach since the project started in 1993 (Table 1).

Reach 5: Seiad Bar river access to China Point river access. A total of 48 redds were counted in this reach during the 2004 survey (Table 1; Figure 9), accounting for 5 % of the season total. Redd density was 2.3 redds/rkm (Figure 3). Peak spawning (n = 17) occurred during both the second (Oct 18 to 22) and third week (October 25 to 29) of the survey. Reach 5 had the lowest count of any reach sampled in 2004 and was the fifth lowest redd count for this reach since the initiation of these surveys in 1993 (Table 1).

Reach 6: China Point river access to Indian Creek. A total of 49 redds were counted in Reach 6 (Table 1; Figure 10), accounting for 5 % of the season total. Redd density was 2.6 redds/rkm (Figure 3), the lowest number observed since the initiation of these surveys (Table 1). Peak spawning (n = 25) in Reach 6 occurred during the third week (October 25 to 29) of this survey (Table 1).

All Reaches

Spawning was observed throughout the mainstem river from IGD to Indian Creek and was consistent with previous survey data in that spatial distribution of redds was relatively lowest in Reach 5 (2.3 redds/rkm) and highest in Reach 1 (23 redds/rkm) and intermediate in reaches 2, 3, 4 and 6 (Table 1; Figure 3). The highest weekly redd count occurred during the fourth survey week (November 1 to 5; n = 607) though this was the only week Reach 1 was surveyed and peak spawning may have occurred one to two weeks prior, as in past years. Overall the 2004 redd survey yielded the second lowest redd count during the period of record (1993 to 2004; Figure 4).

Redd Densities

The 2004 redd counts were highest (43.7 redds/rkm) between IGD and Cape Horn Creek. Redd densities in 2004 were lower than in 2003 for every 10 km section (Table 2). In 2004, the lowest redd densities (0.8 redds/rkm) were in Reach 12 (Shinar Creek to China Creek).

Water Temperature

Mean daily water temperature in 2004 ranged from 6.4 to 16.2 ºC and generally decreased during this survey (October 11 to December 3). Water temperatures continued to decrease during the surveys, even though IGD flows remained fairly stable 914 to 943 cfs (Figure 11).

Table 2. Fall Chinook salmon redds per river kilometer (rkm) for 10 river kilometer (approximate) sections on the mainstem Klamath River, 1993 to 2004 ("Ns" = No survey).

Tributary Reach	Reach Length (rkm)	Year											
		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Iron Gate Dam to Cape Horn Creek	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
Cape Horn Creek to Shasta River	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
Shasta River to Humbug Creek	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
Humbug Creek to Vesa Creek	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
Vesa Creek to Little Humbug Creek	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
Little Humbug Creek to Kohl Creek	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
Kohl Creek to Kinsman Creek	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
Kinsman Creek to Kuntz Creek	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
Kuntz Creek to Walker Creek	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
Walker Creek to Portuguese Creek	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
Portuguese Creek to Shinar Creek	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
Shinar Creek to China Creek	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
China Creek to Ottley Gulch	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
Ottley Gulch to Indian Creek	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

Discharge

Discharges for the 2004 survey ranged from 914 to 943 cfs (Figure 11), which were the lowest range of flows recorded since the initiation of these surveys in 1993. The 2002 flows ranged slightly lower and higher (886 to 1,310 cfs) than those in 2004.

Water Clarity

Vertical Secchi disc readings ranged from 2.5 to 3.0 m. A storm event November 15, 2004 decreased (<1.0 m) the water clarity so surveys were delayed until the river cleared and surveys could resume (November 29). Visibility generally decreased with higher river discharge, cloud cover, and/or precipitation.

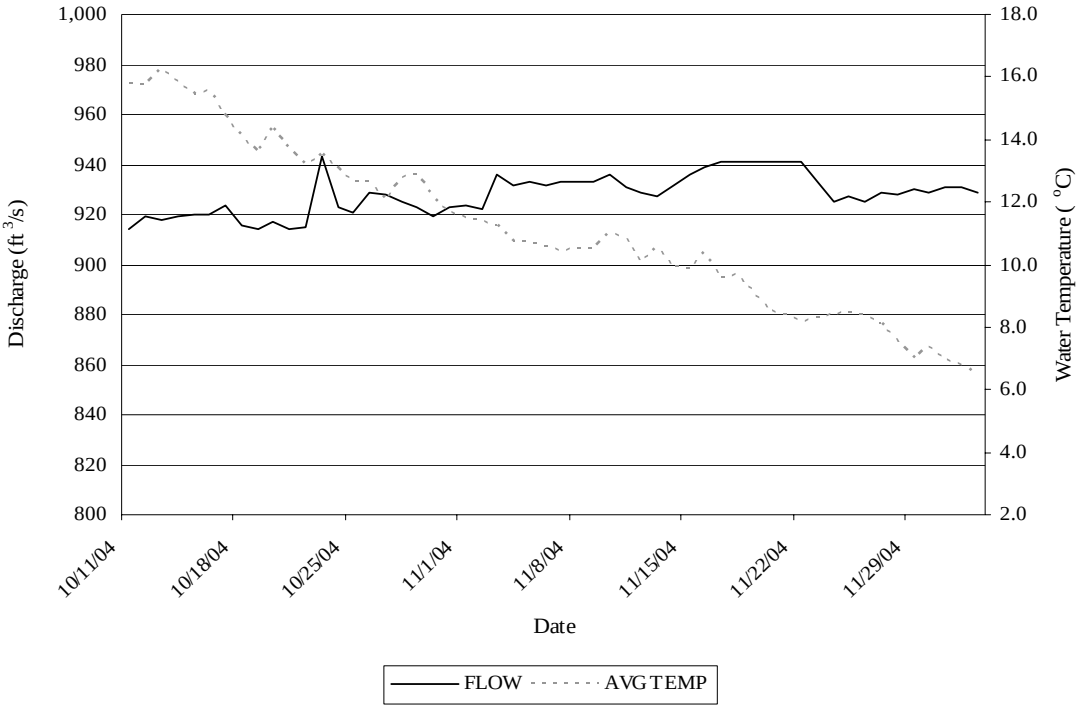

Figure 11. Water temperatures (° C) at river kilometer 288.5 and discharge (ft^3/s) from Iron Gate Dam (October 11 to December 3, 2004).

Suction Dredge Mining

Recreational suction dredge mining was present throughout the survey from the Highway I-5 Bridge to Happy Camp. There was only one redd observed this year on suction dredge tailings. Studies have indicated that redds constructed on dredge tailings are more unstable in high flows than those on naturally deposited substrate (Harvey and Lisle 1999).

Adult Grilse Expansion

The CDFG estimated the natural fall Chinook salmon spawner escapement for the mainstem Klamath River for 2004 at 5,037 adults and 205 grilse (Table 3). The adult/grilse estimates are based on male to female ratio and jack percentages observed at upper Klamath River tributary weirs, carcass surveys, and Chinook salmon scale analysis (CDFG 2005; KRTAT 2005). Based on spawning data from mainstem and tributary spawning surveys conducted by AFWO, USFS, CDFG, and Hoopa and Yurok tribes, the CDFG estimated that 46,812 adults spawned in-river or at hatcheries within the Klamath River Basin.

Summary

The fall Chinook salmon redd count of 916 was the second lowest number observed since the initiation of these surveys in 1993. The highest redd count was 4,652 redds observed in 2002. The highest weekly redd count occurred during the fourth survey week (November 1 to 5, 2004; n = 607) though this was the only week Reach 1 was surveyed and peak spawning may have occurred one to two weeks prior, as in past years. In 2004, peak spawning in Reaches 2 to 5 was during the second survey week (October 18 to 22) and Reaches 5 (two peaks) and 6 during the third week (October 25 to 29).

Typical water clarity experienced during the 2004 survey was similar to past survey years (2.5 to 3.0 m). A storm event decreased water clarity (<1.0 m) on November 15 so surveys were delayed until November 29.

Table 3. Natural fall Chinook salmon spawning escapement adult and grilse expansion, Klamath River, 2004 (CDFG 2005).

	Natural Spawners		
Natural Spawning Area	**Grilse**	**Adults**	**Totals**
Mainstem Klamath River Iron Gate Dam to Indian Creek	205	5,037	5,242
Bogus Creek Basin	295	3,493	3,788
Shasta River Basin	129	833	962
Scott River Basin	22	445	467
Salmon River Basin	51	282	333
Misc. Klamath Tributaries upstream of Yurok Reservation	80	477	557
Yurok Reservation tributaries	64	144	208
Total Natural Spawners	**846**	**10,711**	**11,887**

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