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**Mainstem Klamath River Fall Chinook Salmon Redd Survey 2011**

Mark D. Magneson



U.S. Fish and Wildlife Service  
Arcata Fish and Wildlife Office  
1655 Heindon Road  
Arcata, CA 95521  
(707) 882-7201

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Mark Magnuson

*U. S. Fish and Wildlife Service, Arcata Fish and Wildlife Office  
1655 Heindon Road, Arcata, California 95521  
Mark\_D\_Magnuson@fws.gov*

*Abstract.*—This report summarizes the 2011 fall Chinook salmon *Oncorhynchus tshawytscha* redd survey on the mainstem Klamath River and is the nineteenth such summary provided by the Arcata Fish and Wildlife Office. The survey was conducted over an 8-week period (October 12 to December 1, 2011), covering 114.7 river km (rkm) of the mainstem Klamath River located between the Shasta River (rkm 288.5) and Indian Creek (rkm 173.8) confluences. A total of 631 fall Chinook salmon redds were counted in 2011, which was the third lowest count for this section of river since annual surveys began in 1993. Redd counts over the previous 18-year history of this survey ranged from 243 (in 1993) to 2,539 (in 2002). The 2011 count was 31% less than the prior 18-year mean ( $\bar{x} = 921$ ). Redd densities within approximately 10-rkm sections were highest between Ottley Gulch (rkm 183.7) and Indian Creek (17.9 redds/rkm) and lowest between Shasta River and Humbug Creek (rkm 279.7; 0.1 redds/rkm).

### **Introduction**

The Klamath River drains approximately 14,000 km<sup>2</sup> in Oregon and 26,000 km<sup>2</sup> 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 Tribe Reservation, comprising about 219 km<sup>2</sup>, borders the lower 68 rkms of the Klamath River (Figure 1). The Hupa Valley Tribe Reservation (365 km<sup>2</sup>) is located upstream of the confluence of the Klamath and Trinity Rivers. The Karuk Tribe's ancestral territory extends along the Klamath River from Bluff Creek to southern Oregon. The largest tributaries in the basin include the Trinity, Salmon, Scott, and Shasta rivers. Iron Gate Dam (IGD), located 310.3 rkm upstream of the river mouth, is a barrier to upstream passage of anadromous salmonids. Iron Gate Hatchery, located near the base of IGD, was constructed in 1966 to 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 *O. mykiss* that contribute to economically and culturally important subsistence, sport, and commercial

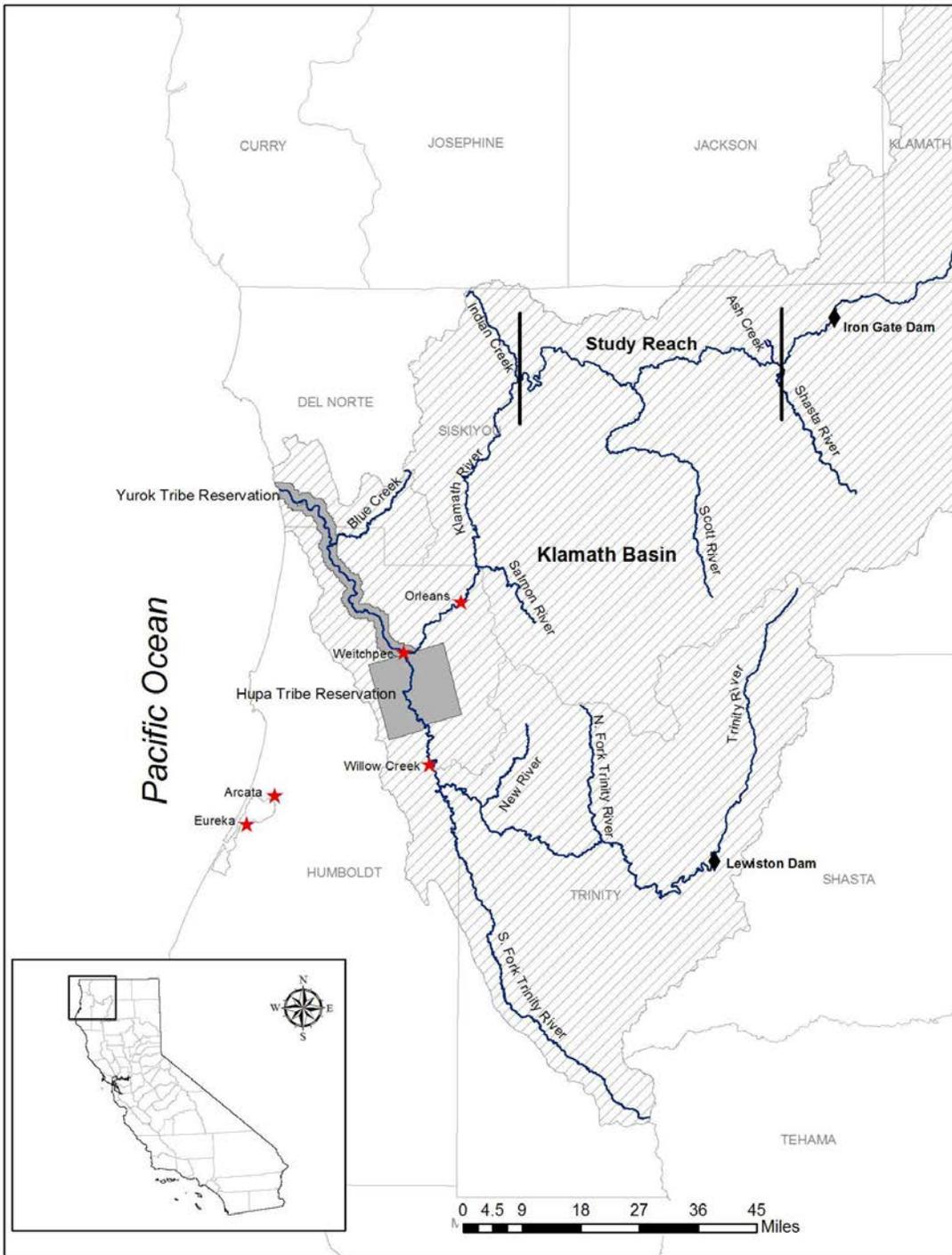


Figure 1. Klamath River Basin, northern California. The mainstem Klamath River redd survey study area extends from the Shasta River to the Indian Creek confluence.

fisheries (Leidy and Leidy 1984). Generations of Native Americans have fished in the drainage, with catches of salmon, steelhead, lamprey, and sturgeon historically providing the mainstay for the tribes. Sport fishing for salmon and steelhead is also popular in the drainage and may exceed 200,000 angler days annually (Leidy and Leidy 1984). During the 1980's, 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).

Chinook salmon populations in the Klamath River Basin have declined from historical levels, in part due to habitat degradation and over-exploitation that has been common to many river systems in the Pacific Northwest (USFWS 1991). Expanded logging and fishing operations, construction of roads and dams, agricultural use, mining, and other forms of anthropogenic development have led to increased concern about the depletion of anadromous salmonid populations and their associated habitats in the basin (Ayres Associates 1999; Flint and Flint 2008).

On October 27, 1986, the United States Congress enacted Public Law 99-552, the Klamath River Fish and Wildlife Restoration Act. Functioning under the guidance of the Klamath River Fishery Management Council (USFWS 1991), 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 (KRBCARP). The U.S. Fish and Wildlife Service (USFWS) was funded through the KRBCARP to identify fall Chinook salmon spawning areas and spawn timing and to collect information necessary to estimate the number of fall Chinook salmon spawning in the mainstem Klamath River between IGD and the confluence of Indian Creek (rkm 173.8; Figure 1). In 1993, the USFWS started conducting fall Chinook salmon redd surveys to estimate escapement within this section of the mainstem Klamath River. In 2001, the USFWS added a second concurrent survey using carcass mark-recapture methods to better estimate escapement in the more densely used spawning area between IGD and the Shasta River confluence (rkm 288.5; Gough and Williamson 2012). During the five years when both carcass and redd surveys were conducted in this stretch of the river (2001 to 2004, 2006), the ratio of the successfully spawned female escapement estimate to observed redds ranged from 3.3:1 (2002) to 4.8:1 (2003). Below the Shasta River there are not enough carcasses found to conduct a mark-recapture survey. However the negative downstream decay of the successfully spawned females–redd ratio within the carcass study area suggests that redd surveys in the less-densely used spawning area below the Shasta River confluence provide sufficient redd counts (Gough and Williamson 2012). This report summarizes the 2011 redd surveys in the mainstem Klamath River between the Shasta River and Indian Creek. The Klamath River Technical Team (KRTT) uses this information to assess basin-wide spawning escapement and to generate stock projections for harvest management (KRTT 2012).

## Methods

### Survey Reaches

The survey area is divided into six reaches based on accessibility and distance that a single crew can survey in a day (Figure 2; Table 1). Reach 1 (IGD to Shasta River) was not surveyed in 2011 because a carcass mark-recapture estimator is now used to derive the number of fall Chinook salmon that spawn in this reach. This was the sixth year (2005, 2007–2011) since 1993 that this reach was not included in the redd survey. The upper 2.8 rkm in Reach 2, from the Shasta River to Ash Creek, was not surveyed because past surveys revealed little to no spawning activity in this section of the river. We assumed no redds were constructed in this short stretch in 2011.

### Data Collection

#### *Redd Data*

Weekly visual redd counts were conducted on the five mainstem reaches from the Shasta River to Indian Creek. Two crews, each consisting of a rower and observer, aided by polarized glasses, surveyed the river by cataraft. Rafts were oared downstream and maneuvered in a zigzag pattern over spawning areas in order to sufficiently census redds. Side and split channels were surveyed by foot or floated on alternating weeks. Crews were assigned the same survey reaches throughout the sampling period under the assumption that increased familiarity with spawning areas facilitated more accurate redd counts (Table 1).

Flagging was used to mark redd locations. Flags were attached to vegetation on the riverbank just downstream of the last observed redd within a habitat unit. A different flag color was used each week to distinguish redd counts on subsequent surveys. Each flag was labeled with the following information: date, surveyors, location (nearest 0.05 rkm), number of old and new redds, and location in channel. Reach, flag location, GPS coordinates, numbers of old and new redds, location in channel, distance from bank, and age(s) of redd(s) were recorded on data forms. Estimated redd age was recorded using a scale of 1 to 3 where:

- redd age 1 = less than two weeks old, characterized by bright substrate, little or no periphyton, and a well-developed mound,
- redd age 2 = two to four weeks old, characterized by a slightly flattened mound and dulled substrate due to periphyton growth, and
- redd age 3 = older than four weeks, identifiable only by the presence of a pit and/or mound. The brightness of the substrate on age code '3' was typically not distinguishable from that of the surrounding substrate.

Only completed redds, identified by a pit and mound, were counted. Test redds (i.e., those without a completed pit and mound) were not included in the count.

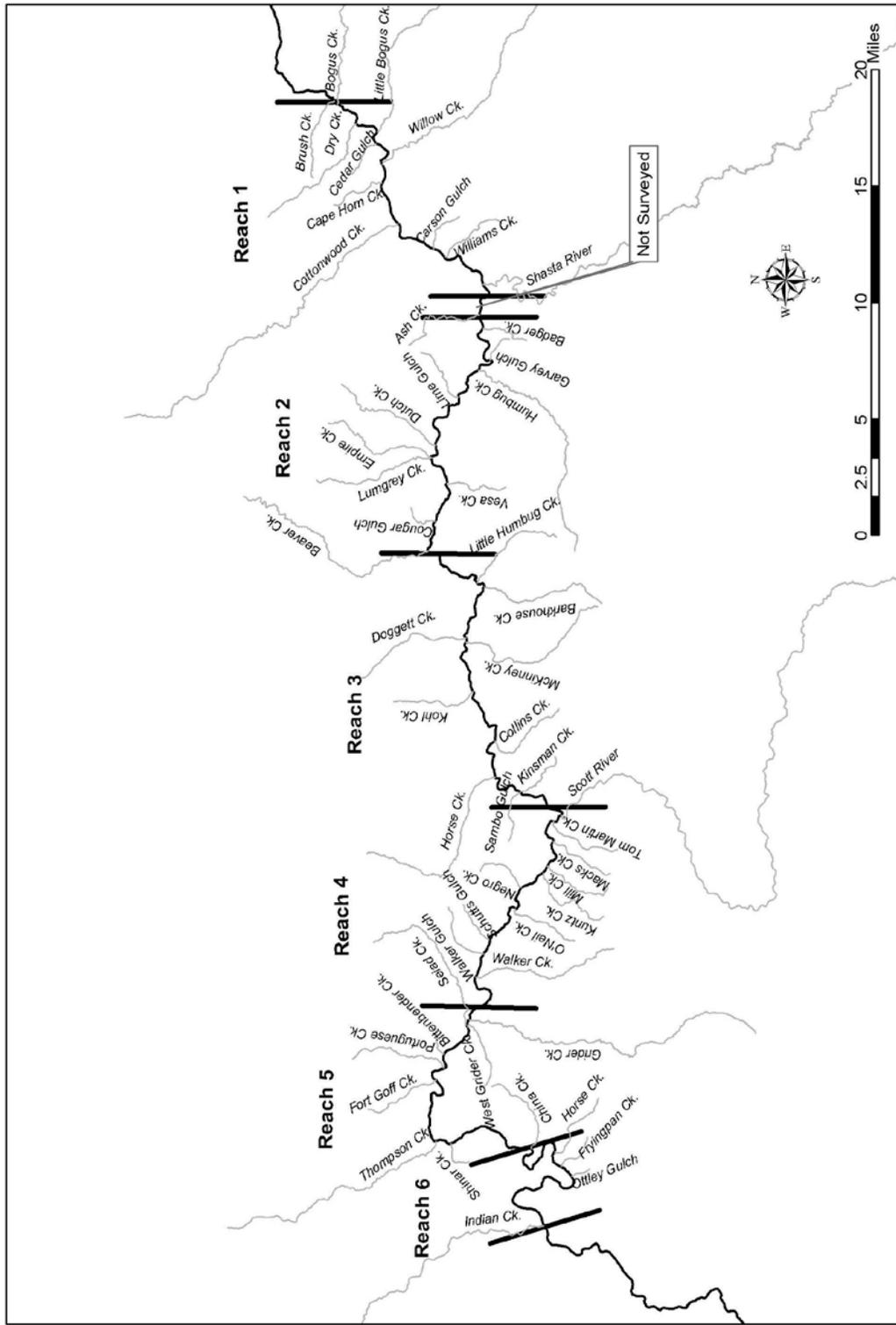


Figure 2. Mainstem Klamath River fall Chinook salmon redd survey reaches (1 to 6). Note: Redd surveys were not conducted in Reach 1 (Iron Gate Dam to Shasta River). The 2.8-rkm section between the Shasta River and Ash Creek was also not surveyed because past surveys revealed a lack of spawning activity in this stretch of river.

Table 1. Location and length of mainstem Klamath River fall Chinook salmon redd survey reaches.

| Reach number   | Upper boundary            |       | Lower boundary |       | Reach length (rkm) |
|----------------|---------------------------|-------|----------------|-------|--------------------|
|                | Location                  | rkm   | Location       | rkm   |                    |
| 1 <sup>a</sup> | Iron Gate Dam             | 310.3 | Shasta River   | 288.4 | 21.9               |
| 2 <sup>b</sup> | Shasta River <sup>c</sup> | 288.4 | Beaver Creek   | 261.9 | 26.5               |
| 3 <sup>d</sup> | Beaver Creek              | 261.9 | Blue Heron     | 234.3 | 27.6               |
| 4 <sup>b</sup> | Blue Heron                | 234.3 | Seiad Bar      | 213.6 | 20.7               |
| 5 <sup>d</sup> | Seiad Bar                 | 213.6 | China Point    | 192.4 | 21.2               |
| 6 <sup>e</sup> | China Point               | 192.4 | Indian Creek   | 173.8 | 18.6               |

<sup>a</sup> Reach 1 not surveyed for redds (escapement in this reach estimated from carcass mark-recapture surveys by USFWS and the Yurok Tribe).

<sup>b</sup> Surveyed by Karuk Tribe crew.

<sup>c</sup> The section of river between Shasta River and Ash Creek (rkm 285.7) was not surveyed because past surveys revealed little to no spawning activity in this area.

<sup>d</sup> Surveyed by USFWS crew.

<sup>e</sup> Reach 6 split at Gordons Ferry (rkm 185.0) and surveyed by Karuk Tribe and USFWS crews.

### *Water Quality*

Water temperature was recorded using Onset® HOB0 Water Temp Pro v2 Model Number U22-001loggers (Onset Computer Corp., Bourne, MA) placed below the bridge at the Iron Gate Hatchery (rkm 309.9) and below Seiad Valley at USGS Gauging Station 11520500 (rkm 206.8). Temperatures were recorded at 1-hr intervals throughout the survey period. Secchi disk depth was taken each survey as a measure of water visibility.

### *Discharge*

Mean daily river flow was obtained from the U.S. Geological Survey Gauging Station 11516530, located in the Klamath River just downstream of IGD, and 11520500, in the Klamath River near Seiad Valley, California.

## **Data Analyses**

### *Adult and Jack Escapement Estimates*

The total number of single-counted redds in this survey was used to estimate adult and jack (age-2 males) fall Chinook salmon escapement that spawned between the Shasta River and Indian Creek. Assuming each redd represents one male and one female adult salmon, adult escapement ( $N_{adult}$ ) was estimated by multiplying the total redd count ( $R$ ) by two:

$$\hat{N}_{adult} = 2R.$$

The age composition of mainstem Chinook salmon from the IGD–Shasta River carcass survey (KRTT 2012) was used as a surrogate for apportioning escapement by age class in the mainstem Klamath River below the Shasta River. Jack (age-2 fish) escapement ( $N_{jack}$ ) was estimated by

$$\hat{N}_{jack} = \frac{\hat{N}_{adult}}{(1 - P_{age2})} - \hat{N}_{adult},$$

where  $P_{age2}$  is the jack proportion based on scale readings from the carcass survey.

### *Redd Densities*

Redd densities were calculated at both the reach and 10-rkm spatial distribution levels. The latter analysis provides an improved spatial resolution of redd distribution.

## **Results and Discussion**

### **Adult and Jack Escapement**

We observed 631 fall Chinook salmon redds in 2011, representing 1,262 adults in the mainstem Klamath River between the Shasta River and Indian Creek confluences (Reaches 2 to 6; Table 2). Applying the surrogate jack proportion of 45.67% from the IGD–Shasta River carcass survey, jack escapement was estimated to be 1,061. These differed slightly from the KRTT’s preliminary estimates of 1,260 adults and 1,059 jacks. Carcass mark-recapture methods and carcass scale ages produced estimates of 2,716 adult and 2,247 jack fall Chinook salmon that spawned between IGD and the Shasta River (KRTT 2012). Our 2011 redd count was 31% less than the previous 18-year mean ( $\bar{x} = 921$ ) for the five surveyed reaches. The combined redd count for the five surveyed reaches in 2011 was the third lowest in the 19-year history of this survey, with the highest count occurring in 2002 ( $n = 2,539$ ) and the lowest in 1993 ( $n = 243$ ; Table 3; Figure 3).

Redd counts stratified by survey week and reach for survey years 1993 to 2011 are summarized in Table 3. Peak redd counts occurred during Calendar Week 43 for Reach 6, Calendar Week 44 for Reaches 2, 4, and 5, and Calendar Week 45 for Reach 3 in 2011. Redd densities by reach are presented in Figure 4. The highest concentration of redds was in Reach 6 (17.5 redds/rkm) and the lowest was in Reach 2 (1.4 redds/rkm). The spatial distribution of redds was slightly different from most previous years’ surveys in that the lowest densities were in Reach 2 instead of Reach 5 (4.3 redds/rkm). The spatial distributions of redds in each reach are displayed in Figure 5 through 9.

### **10-Rkm Section Redd Densities**

In 2011 the 10-rkm section between Ottley Gulch (rkm 183.7) and Indian Creek had the highest redd density (17.9 redds/rkm) of all 12 approximate 10-rkm sections surveyed. The lowest density was observed between the Shasta River and Humbug Creek (rkm 279.7; 0.1 redd/rkm; Table 4). Compared to previous years, densities were the lowest on record for the Shasta River to Humbug Creek and Humbug Creek to Vesa

Table 2 Estimates of in-river fall Chinook salmon spawning escapement in the mainstem Klamath River, 2011 (data compiled from CDFG 2012).

| <b>Natural Spawning Area</b>                 | <b>Jacks</b>  | <b>Adults</b> | <b>Totals</b>  |
|--|---------------|---------------|----------------|
| <b>Mainstem Klamath River</b>                |               |               |                |
| Iron Gate Dam to Shasta River <sup>a</sup>   | 2,247         | 2,716         | 4,963          |
| Shasta River to Indian Creek <sup>b</sup>    | 1,059         | 1,260         | 2,319          |
| Bogus Creek Basin                            | 2,303         | 2,919         | 5,222          |
| Shasta River Basin                           | 11,187        | 213           | 11,400         |
| Scott River Basin                            | 2,499         | 3,016         | 5,515          |
| Salmon River Basin                           | 1,819         | 3,674         | 5,493          |
| <b>Misc. Klamath Tributaries upstream of</b> |               |               |                |
| Yurok Reservation                            | 3,259         | 3,072         | 6,331          |
| Yurok Reservation Tributaries                | 418           | 1,143         | 1,561          |
| <b>Total Natural Klamath Spawners</b>        | <b>24,791</b> | <b>18,013</b> | <b>42,804</b>  |
| <b>Mainstem Trinity River</b>                |               |               |                |
| Mainstem Trinity River                       | 37,818        | 28,670        | 66,488         |
| Misc. Trinity Tributaries                    | 96            | 542           | 638            |
| Hoopla Reservation Tributaries               | 94            | 530           | 624            |
| <b>Total Natural Trinity Spawners</b>        | <b>38,008</b> | <b>29,742</b> | <b>67,750</b>  |
| <b>Grand Total Natural Spawners</b>          | <b>62,799</b> | <b>47,755</b> | <b>110,554</b> |

<sup>a</sup> USFWS and Yurok Tribe carcass mark-recapture survey.

<sup>b</sup> USFWS and Karuk Tribe redd survey. Shasta River (rkm 288.4) to Ash Creek (rkm 285.7) not surveyed.

Table 3. Weekly reach summary of mainstem Klamath River fall Chinook salmon redd counts, 1993 to 2011 [Ns = no survey, R1 = Iron Gate Dam to Shasta River, R2 = Shasta River to Beaver Creek (note: the 2.8-rkm section from the Shasta River to Ash Creek was not surveyed and assumed to have no redds), R3 = Beaver Creek to Blue Heron river access, R4 = Blue Heron river access to Seiad Bar, R5 = Seiad Bar to China Point, R6 = China Point to Indian Creek].

| Year | Calendar         |                 | Reach |       |      |       |       |     | Total        |
|------|------------------|-----------------|-------|-------|------|-------|-------|-----|--------------|
|      | Week             | Survey dates    | R1    | R2    | R3   | R4    | R5    | R6  |              |
| 1993 | 44               | Oct 25 to 29    | 15    | 13    | 30   | 18    | 16    | 81  | 173          |
|      | 45               | Nov 1 to 5      | 67    | 24    | 4    | 1     | 15    | 5   | 116          |
|      | 46               | Nov 8 to 12     | 5     | 1     | 18   | 7     | 0     | 1   | 32           |
|      | 47               | Nov 15 to 18    | 0     | 0     | 4    | 5     | 0     | 0   | 9            |
|      |                  | Reach Total     | 87    | 38    | 56   | 31    | 31    | 87  | <b>330</b>   |
|      | Percent of Total | 26.4%           | 11.5% | 17.0% | 9.4% | 9.4%  | 26.4% |     |              |
| 1994 | 43               | Oct 17 to 21    | 89    | 28    | 48   | Ns    | Ns    | 98  | 263          |
|      | 44               | Oct 24 to 28    | 278   | 59    | 77   | 113   | 98    | 124 | 749          |
|      | 45               | Oct 31 to Nov 4 | 375   | 20    | 46   | 42    | 16    | 33  | 532          |
|      | 46               | Nov 7 to 11     | 86    | Ns    | Ns   | Ns    | Ns    | Ns  | 86           |
|      | 47               | Nov 14 to 18    | 3     | 2     | 7    | 4     | 5     | 5   | 26           |
|      |                  | Reach Total     | 831   | 109   | 178  | 159   | 119   | 260 | <b>1,656</b> |
|      | Percent of Total | 50.2%           | 6.6%  | 10.7% | 9.6% | 7.2%  | 15.7% |     |              |
| 1995 | 42               | Oct 16 to 20    | 138   | 12    | 70   | 26    | 30    | 139 | 415          |
|      | 43               | Oct 23 to 27    | 598   | 82    | 199  | 94    | 91    | 169 | 1,233        |
|      | 44               | Oct 30 to Nov 3 | 727   | 58    | 78   | 35    | 57    | 112 | 1,067        |
|      | 45               | Nov 6 to 10     | 277   | 26    | 49   | 13    | 25    | 50  | 440          |
|      | 46               | Nov 13 to 17    | Ns    | Ns    | Ns   | Ns    | Ns    | Ns  | 0            |
|      | 47               | Nov 20 to 24    | Ns    | Ns    | Ns   | Ns    | Ns    | Ns  | 0            |
|      | 48               | Nov 27 to Dec 1 | 39    | 9     | 14   | 4     | 12    | 3   | 81           |
|      |                  | Reach Total     | 1,779 | 187   | 410  | 172   | 215   | 473 | <b>3,236</b> |
|      | Percent of Total | 55.0%           | 5.8%  | 12.7% | 5.3% | 6.6%  | 14.6% |     |              |
| 1996 | 43               | Oct 21 to 25    | 290   | 31    | 96   | 10    | 118   | 39  | 584          |
|      | 44               | Oct 28 to Nov 1 | 291   | 29    | 25   | 22    | 42    | 92  | 501          |
|      | 45               | Nov 4 to 8      | 83    | 4     | 24   | 8     | 33    | 59  | 211          |
|      | 46               | Nov 11 to 15    | 40    | 0     | 6    | 0     | 7     | 23  | 76           |
|      |                  | Reach Total     | 704   | 64    | 151  | 40    | 200   | 213 | <b>1,372</b> |
|      | Percent of Total | 51.3%           | 4.7%  | 11.0% | 2.9% | 14.6% | 15.5% |     |              |
| 1997 | 42               | Oct 16          | 272   | Ns    | Ns   | Ns    | Ns    | Ns  | 272          |
|      | 43               | Oct 20 to 24    | 252   | 37    | 69   | 89    | 29    | 136 | 612          |
|      | 44               | Oct 27 to 31    | 424   | 18    | 76   | 52    | 22    | 76  | 668          |
|      | 45               | Nov 3 to 7      | 70    | 7     | 13   | 16    | 8     | 27  | 141          |
|      | 46               | Nov 10 to 14    | 2     | 14    | 4    | 5     | 3     | 18  | 46           |
|      |                  | Reach Total     | 1,020 | 76    | 162  | 162   | 62    | 257 | <b>1,739</b> |
|      | Percent of Total | 58.7%           | 4.4%  | 9.3%  | 9.3% | 3.6%  | 14.8% |     |              |

Table 3 (continued). Weekly reach summary of mainstem Klamath River fall Chinook salmon redd counts, 1993 to 2011 [Ns = no survey, R1 = Iron Gate Dam to Shasta River, R2 = Shasta River to Beaver Creek (note: the 2.8-rkm section from the Shasta River to Ash Creek was not surveyed and assumed to have no redds), R3 = Beaver Creek to Blue Heron river access, R4 = Blue Heron river access to Seiad Bar, R5 = Seiad Bar to China Point, R6 = China Point to Indian Creek].

| Year | Calendar         |                 | Reach |       |       |      |       |     | Total        |
|------|------------------|-----------------|-------|-------|-------|------|-------|-----|--------------|
|      | Week             | Survey dates    | R1    | R2    | R3    | R4   | R5    | R6  |              |
| 1998 | 42               | Oct 14 to 15    | 89    | Ns    | Ns    | Ns   | Ns    | Ns  | 89           |
|      | 43               | Oct 19 to 23    | 180   | 45    | 67    | 15   | 20    | 45  | 372          |
|      | 44               | Oct 26 to 30    | 368   | 11    | 12    | 14   | 7     | 39  | 451          |
|      | 45               | Nov 2 to 6      | 226   | 22    | 33    | 10   | 9     | 28  | 328          |
|      | 46               | Nov 9 to 12     | 135   | 3     | 11    | 3    | 2     | 2   | 156          |
|      | 47               | Nov 15 to 19    | 12    | 1     | 3     | 0    | 1     | 2   | 19           |
|      |                  | Reach Total     | 1,010 | 82    | 126   | 42   | 39    | 116 | <b>1,415</b> |
|      | Percent of Total | 71.4%           | 5.8%  | 8.9%  | 3.0%  | 2.8% | 8.2%  |     |              |
| 1999 | 42               | Oct 13 to 15    | 98    | 3     | Ns    | Ns   | Ns    | Ns  | 101          |
|      | 43               | Oct 18 to 22    | 200   | 27    | 31    | 17   | 23    | 39  | 337          |
|      | 44               | Oct 25 to 27    | 304   | 23    | 20    | Ns   | Ns    | Ns  | 347          |
|      | 45               | Nov 1 to 5      | 83    | 12    | 9     | 8    | 8     | 19  | 139          |
|      | 46               | Nov 8 to 12     | 37    | 2     | 2     | 1    | 5     | 11  | 58           |
|      | 47               | Nov 15 to 19    | 1     | 2     | 0     | 2    | 2     | 0   | 7            |
|      |                  | Reach Total     | 723   | 69    | 62    | 28   | 38    | 69  | <b>989</b>   |
|      | Percent of Total | 73.1%           | 7.0%  | 6.3%  | 2.8%  | 3.8% | 7.0%  |     |              |
| 2000 | 43               | Oct 16 to 20    | 327   | 92    | 69    | 25   | 10    | 19  | 542          |
|      | 44               | Oct 23 to 27    | 146   | 62    | 34    | 52   | 10    | 53  | 357          |
|      | 45               | Oct 30 to Nov 3 | 254   | 42    | 69    | 54   | 20    | 86  | 525          |
|      | 46               | Nov 6 to 10     | 57    | 12    | 15    | 21   | 2     | 16  | 123          |
|      | 47               | Nov 13 to 17    | 4     | 0     | 9     | 12   | 0     | 6   | 30           |
|      | 48               | Nov 20 to 22    | 1     | Ns    | Ns    | Ns   | Ns    | Ns  | 1            |
|      |                  | Reach Total     | 788   | 208   | 196   | 164  | 42    | 180 | <b>1,578</b> |
|      | Percent of Total | 49.9%           | 13.2% | 12.4% | 10.4% | 2.7% | 11.4% |     |              |
| 2001 | 42               | Oct 15 to 19    | 92    | 24    | 28    | 21   | 2     | 23  | 190          |
|      | 43               | Oct 22 to 26    | 168   | 102   | 128   | 59   | 40    | 82  | 579          |
|      | 44               | Oct 29 to Nov 2 | 323   | 97    | 170   | 102  | 55    | 139 | 886          |
|      | 45               | Nov 5 to 9      | 155   | 10    | 40    | 12   | 31    | 29  | 277          |
|      | 46               | Nov 12 to 16    | 75    | 31    | 49    | 22   | 9     | Ns  | 186          |
|      | 47               | Nov 19 to 23    | Ns    | Ns    | Ns    | Ns   | Ns    | Ns  | 0            |
|      | 48               | Nov 26 to 30    | 17    | Ns    | Ns    | Ns   | Ns    | Ns  | 17           |
|      | 49               | Dec 3 to 7      | Ns    | Ns    | 12    | Ns   | Ns    | 5   | 17           |
|      | 50               | Dec 10 to 14    | Ns    | 5     | 8     | 4    | 3     | Ns  | 20           |
|      |                  | Reach Total     | 830   | 269   | 435   | 220  | 140   | 278 | <b>2,172</b> |
|      | Percent of Total | 38.2%           | 12.4% | 20.0% | 10.1% | 6.4% | 12.8% |     |              |
| 2002 | 41               | Oct 10          | 8     | Ns    | Ns    | Ns   | Ns    | Ns  | 8            |
|      | 42               | Oct 15 to 18    | 124   | 90    | 120   | 71   | 61    | 146 | 612          |
|      | 43               | Oct 21 to 25    | 885   | 198   | 340   | 186  | 141   | 181 | 1,931        |
|      | 44               | Oct 29 to Nov 1 | 549   | 112   | 148   | 90   | 69    | 66  | 1,034        |
|      | 45               | Nov 4 to 8      | 335   | 90    | 62    | 38   | 20    | 21  | 566          |
|      | 46               | Nov 12 to 15    | 136   | 56    | 39    | 46   | 14    | 65  | 356          |
|      | 47               | Nov 19 to 22    | 76    | 20    | 10    | 10   | 5     | 15  | 136          |
|      | 48               | Nov 26 to 29    | Ns    | Ns    | Ns    | Ns   | Ns    | Ns  | 0            |
|      | 49               | Dec 2 to 6      | 0     | 0     | 7     | 0    | 1     | 1   | 9            |
|      |                  | Reach Total     | 2,113 | 566   | 726   | 441  | 311   | 495 | <b>4,652</b> |
|      | Percent of Total | 45.4%           | 12.2% | 15.6% | 9.5%  | 6.7% | 10.6% |     |              |

Table 3 (continued Weekly reach summary of mainstem Klamath River fall Chinook salmon redd counts, 1993 to 2011 [Ns = no survey, R1 = Iron Gate Dam to Shasta River, R2 = Shasta River to Beaver Creek (note: the 2.8-rkm section from the Shasta River to Ash Creek was not surveyed and assumed to have no redds), R3 = Beaver Creek to Blue Heron river access, R4 = Blue Heron river access to Seiad Bar, R5 = Seiad Bar to China Point, R6 = China Point to Indian Creek].

| Calendar |      |                               | Reach       |       |       |       |       |       | Total |
|----------|------|-------------------------------|-------------|-------|-------|-------|-------|-------|-------|
| Year     | Week | Survey dates                  | R1          | R2    | R3    | R4    | R5    | R6    |       |
| 2003     | 42   | Oct 14 to 17                  | 0           | Ns    | 38    | 22    | 19    | 48    | 127   |
|          | 43   | Oct 20 to 24                  | 563         | 194   | 228   | 178   | 77    | 150   | 1,390 |
|          | 44   | Oct 27 to 31                  | 553         | 73    | 103   | 18    | 119   | 99    | 965   |
|          | 45   | Nov 4 to 7                    | 310         | 33    | 97    | 61    | 50    | 74    | 625   |
|          | 46   | Nov 12 to 15                  | 44          | 43    | 14    | 11    | 15    | 48    | 175   |
|          | 47   | Nov 19 to 22                  | 2           | 0     | 4     | 2     | 5     | 7     | 20    |
|          |      |                               | Reach Total | 1,472 | 343   | 484   | 292   | 285   | 426   |
|          |      | Percent of Total              | 44.6%       | 10.4% | 14.7% | 8.8%  | 8.6%  | 12.9% |       |
| 2004     | 42   | Oct 11 to 15                  | Ns          | 0     | 6     | 1     | 3     | 0     | 10    |
|          | 43   | Oct 18 to 22                  | Ns          | 57    | 45    | 27    | 17    | 11    | 157   |
|          | 44   | Oct 25 to 29                  | Ns          | 22    | 37    | 9     | 17    | 25    | 110   |
|          | 45   | Nov 1 to 5                    | 513         | 36    | 27    | 14    | 7     | 10    | 607   |
|          | 46   | Nov 8 to 12                   | Ns          | 2     | 10    | 4     | 4     | 3     | 23    |
|          | 49   | Nov 29 to Dec 3               | Ns          | 0     | 9     | 0     | 0     | 0     | 9     |
|          |      |                               | Reach Total | 513   | 117   | 134   | 55    | 48    | 49    |
|          |      | Percent of Total              | 56.0%       | 12.8% | 14.6% | 6.0%  | 5.2%  | 5.3%  |       |
| 2005     | 43   | Oct 18 to 20                  | Ns          | 12    | 14    | 3     | 3     | 27    | 59    |
|          | 44   | Oct 25 to 27                  | Ns          | 10    | 17    | 15    | 17    | 37    | 96    |
|          | 45   | Nov 1 to 3                    | Ns          | 9     | 8     | 8     | 7     | 20    | 52    |
|          | 46   | Nov 8 to 10                   | Ns          | Ns    | Ns    | Ns    | Ns    | Ns    | 0     |
|          | 47   | Nov 15 to 17                  | Ns          | 8     | 1     | 20    | 1     | 31    | 61    |
|          |      |                               | Reach Total | -     | 39    | 40    | 46    | 28    | 115   |
|          |      | Percent of Total <sup>a</sup> | -           | 14.6% | 14.9% | 17.2% | 10.4% | 42.9% |       |
| 2006     | 42   | Oct 16 to 20                  | 109         | 21    | 41    | 66    | 31    | 155   | 423   |
|          | 43   | Oct 23 to 27                  | 167         | 17    | 30    | 61    | 21    | 55    | 351   |
|          | 44   | Oct 30 to Nov 3               | 96          | 10    | 33    | 12    | Ns    | 6     | 157   |
|          | 45   | Nov 6 to 10                   | 66          | 3     | 9     | 7     | 19    | 110   | 214   |
|          | 46   | Nov 13 to 15                  | 15          | 6     | 4     | Ns    | Ns    | Ns    | 25    |
|          | 47   | Nov 20 to 24                  | Ns          | Ns    | Ns    | Ns    | Ns    | Ns    | 0     |
|          | 48   | Nov 29                        | Ns          | Ns    | Ns    | Ns    | Ns    | 16    | 16    |
|          |      |                               | Reach Total | 453   | 57    | 117   | 146   | 71    | 342   |
|          |      | Percent of Total              | 38.2%       | 4.8%  | 9.9%  | 12.3% | 6.0%  | 28.8% |       |
| 2007     | 42   | Oct 16 to 18                  | Ns          | 24    | 17    | 36    | 5     | 42    | 124   |
|          | 43   | Oct 23 to 25                  | Ns          | 12    | 53    | 15    | 25    | 67    | 172   |
|          | 44   | Oct 30 to Nov 1               | Ns          | 25    | 32    | 47    | 21    | 90    | 215   |
|          | 45   | Nov 5 to 8                    | Ns          | 27    | 24    | 37    | 8     | 72    | 168   |
|          | 46   | Nov 14 to 16                  | Ns          | 1     | 7     | 3     | 5     | 9     | 25    |
|          | 47   | Nov 21 to 23                  | Ns          | Ns    | Ns    | Ns    | Ns    | Ns    | 0     |
|          | 48   | Nov 28 to 29                  | Ns          | Ns    | 3     | Ns    | 1     | 4     | 8     |
|          |      |                               | Reach Total | -     | 89    | 136   | 138   | 65    | 284   |
|          |      | Percent of Total <sup>a</sup> | -           | 12.5% | 19.1% | 19.4% | 9.1%  | 39.9% |       |

<sup>a</sup> Reach 1 was not surveyed.

Table 3 (continued). Weekly reach summary of mainstem Klamath River fall Chinook salmon redd counts, 1993 to 2011 [Ns = no survey, R1 = Iron Gate Dam to Shasta River, R2 = Shasta River to Beaver Creek (note: the 2.8-rkm section from the Shasta River to Ash Creek was not surveyed and assumed to have no redds), R3 = Beaver Creek to Blue Heron river access, R4 = Blue Heron river access to Seiad Bar, R5 = Seiad Bar to China Point, R6 = China Point to Indian Creek].

| Year | Calendar                      |                               | Reach |       |       |       |       |       | Total                     |
|------|-------------------------------|-------------------------------|-------|-------|-------|-------|-------|-------|---------------------------|
|      | Week                          | Survey dates                  | R1    | R2    | R3    | R4    | R5    | R6    |                           |
| 2008 | 42                            | Oct 15 to 17                  | Ns    | 3     | 24    | 13    | 12    | 12    | 64                        |
|      | 43                            | Oct 21 to 23                  | Ns    | 61    | 24    | 63    | 10    | 60    | 218                       |
|      | 44                            | Oct 28 to 30                  | Ns    | 30    | 39    | 49    | 36    | 129   | 283                       |
|      | 45                            | Nov 4 to 6                    | Ns    | 42    | 33    | 23    | 19    | 108   | 225                       |
|      | 46                            | Nov 11 to 13                  | Ns    | 6     | 4     | 19    | 14    | 31    | 74                        |
|      | 47                            | Nov 18 to 20                  | Ns    | 5     | 5     | 3     | 1     | 14    | 28                        |
|      | 48                            | Nov 25 to 27                  | Ns                        |
|      | 49                            | Dec 2 to 4                    | Ns    | 0     | 6     | 0     | 0     | 0     | 6                         |
|      |                               | Reach Total                   | -     | 147   | 135   | 170   | 92    | 354   | <b>898</b> <sup>a</sup>   |
|      | Percent of Total <sup>a</sup> | -                             | 16.4% | 15.0% | 18.9% | 10.2% | 39.4% |       |                           |
| 2009 | 42                            | Oct 14 to 16                  | Ns    | 21    | 61    | 42    | 33    | 127   | 284                       |
|      | 43                            | Oct 20 to 22                  | Ns    | 64    | 103   | 71    | 53    | 247   | 538                       |
|      | 44                            | Oct 27 to 29                  | Ns    | 30    | 108   | 92    | 69    | 130   | 429                       |
|      | 45                            | Nov 3 to 5                    | Ns    | 69    | 48    | 110   | 37    | 183   | 447                       |
|      | 46                            | Nov 10 to 12                  | Ns    | 17    | 14    | 23    | 20    | 31    | 105                       |
|      | 47                            | Nov 17 to 19                  | Ns    | 0     | 11    | 4     | 6     | 15    | 36                        |
|      | 48                            | Nov 24 to 26                  | Ns    | Ns    | Ns    | Ns    | Ns    | Ns    | 0                         |
|      | 49                            | Dec. 2 to 4                   | Ns    | 0     | 0     | 0     | 0     | 1     | 1                         |
|      |                               | Reach Total                   | -     | 201   | 345   | 342   | 218   | 734   | <b>1,840</b> <sup>a</sup> |
|      | Percent of Total <sup>a</sup> | -                             | 10.9% | 18.8% | 18.6% | 11.8% | 39.9% |       |                           |
| 2010 | 42                            | Oct 13 to 15                  | Ns    | 0     | 1     | 17    | 6     | 16    | 40                        |
|      | 43                            | Oct 19 to 21                  | Ns    | 37    | 19    | 36    | 19    | 99    | 210                       |
|      | 44                            | Oct 26 to 28                  | Ns    | 34    | 18    | 39    | 12    | 44    | 147                       |
|      | 45                            | Nov 2 to 4                    | Ns    | 14    | 3     | 30    | 5     | 67    | 119                       |
|      | 46                            | Nov 10 to 12                  | Ns    | 2     | 12    | 15    | 9     | 56    | 94                        |
|      | 47                            | Nov 16 to 18                  | Ns    | 0     | 0     | 11    | 6     | 10    | 27                        |
|      | 48                            | Nov 23 to 25                  | Ns    | Ns    | Ns    | Ns    | Ns    | Ns    | 0                         |
|      | 49                            | Nov 30 to Dec 2               | Ns    | 0     | 4     | 0     | 4     | 1     | 9                         |
|      |                               | Reach Total                   | -     | 87    | 57    | 148   | 61    | 293   | <b>646</b> <sup>a</sup>   |
|      | Percent of Total <sup>a</sup> | -                             | 13.5% | 8.8%  | 22.9% | 9.4%  | 45.4% |       |                           |
| 2011 | 42                            | Oct 12 to 14                  | Ns    | 0     | 5     | 4     | 0     | 7     | 16                        |
|      | 43                            | Oct 18 to 20                  | Ns    | 2     | 4     | 17    | 14    | 97    | 134                       |
|      | 44                            | Oct 25 to 27                  | Ns    | 20    | 20    | 29    | 43    | 89    | 201                       |
|      | 45                            | Nov 1 to 3                    | Ns    | 1     | 22    | 14    | 10    | 80    | 127                       |
|      | 46                            | Nov 8 to 10                   | Ns    | 11    | 31    | 0     | 16    | 32    | 90                        |
|      | 47                            | Nov 15 to 17                  | Ns    | 0     | 18    | 8     | 5     | 23    | 54                        |
|      | 49                            | Nov 29 to Dec 1               | Ns    | 0     | 5     | 0     | 4     | 0     | 9                         |
|      |                               | Reach Total                   | -     | 34    | 105   | 72    | 92    | 328   | <b>631</b> <sup>a</sup>   |
|      |                               | Percent of Total <sup>a</sup> | -     | 5.4%  | 16.6% | 11.4% | 14.6% | 52.0% |                           |

<sup>a</sup> Reach 1 was not surveyed.

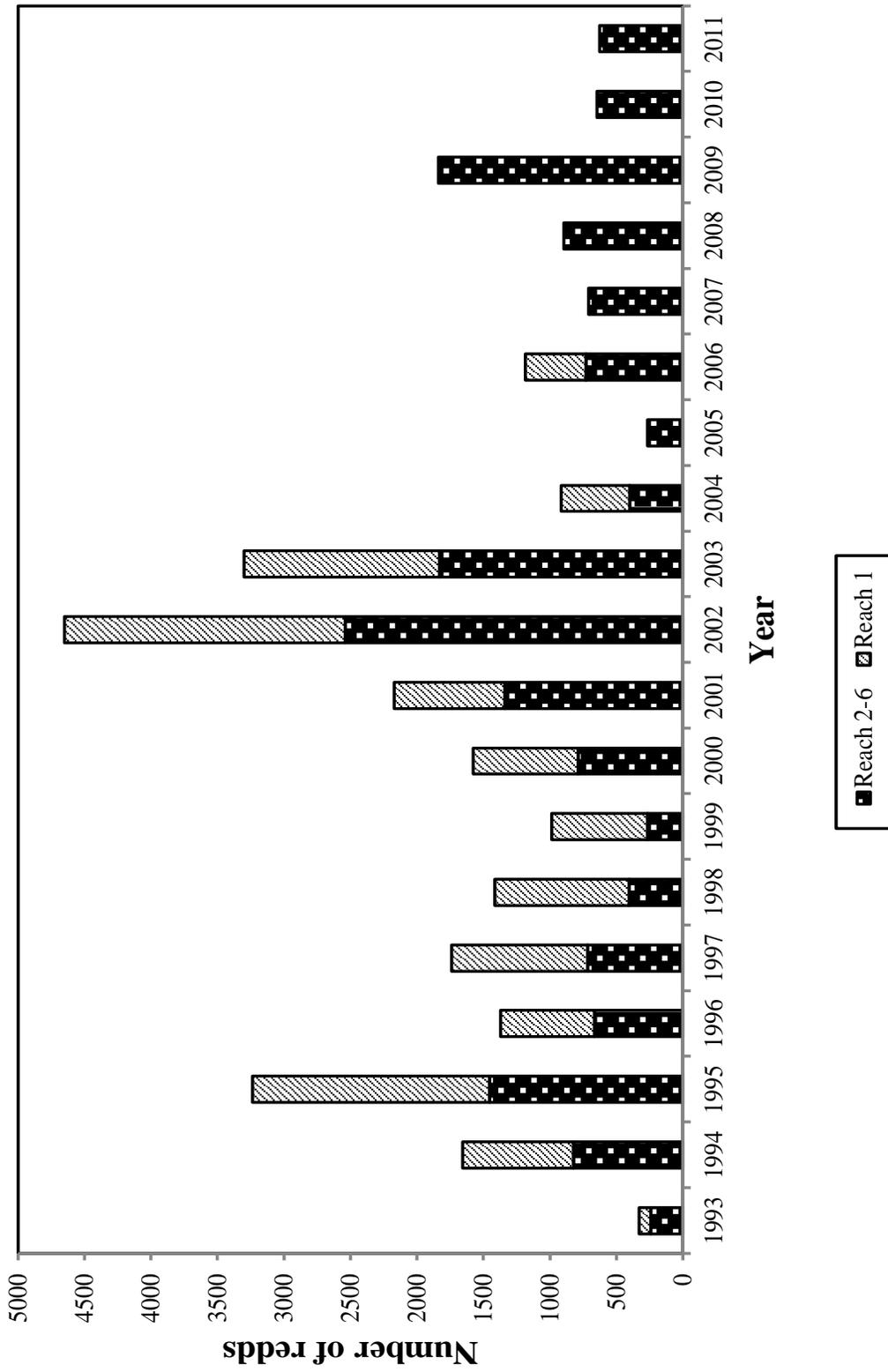


Figure 3. Mainstem Klamath River fall Chinook salmon redd counts 1993 to 2011. Reach 1 was not surveyed in 2005 and 2007 through 2011.

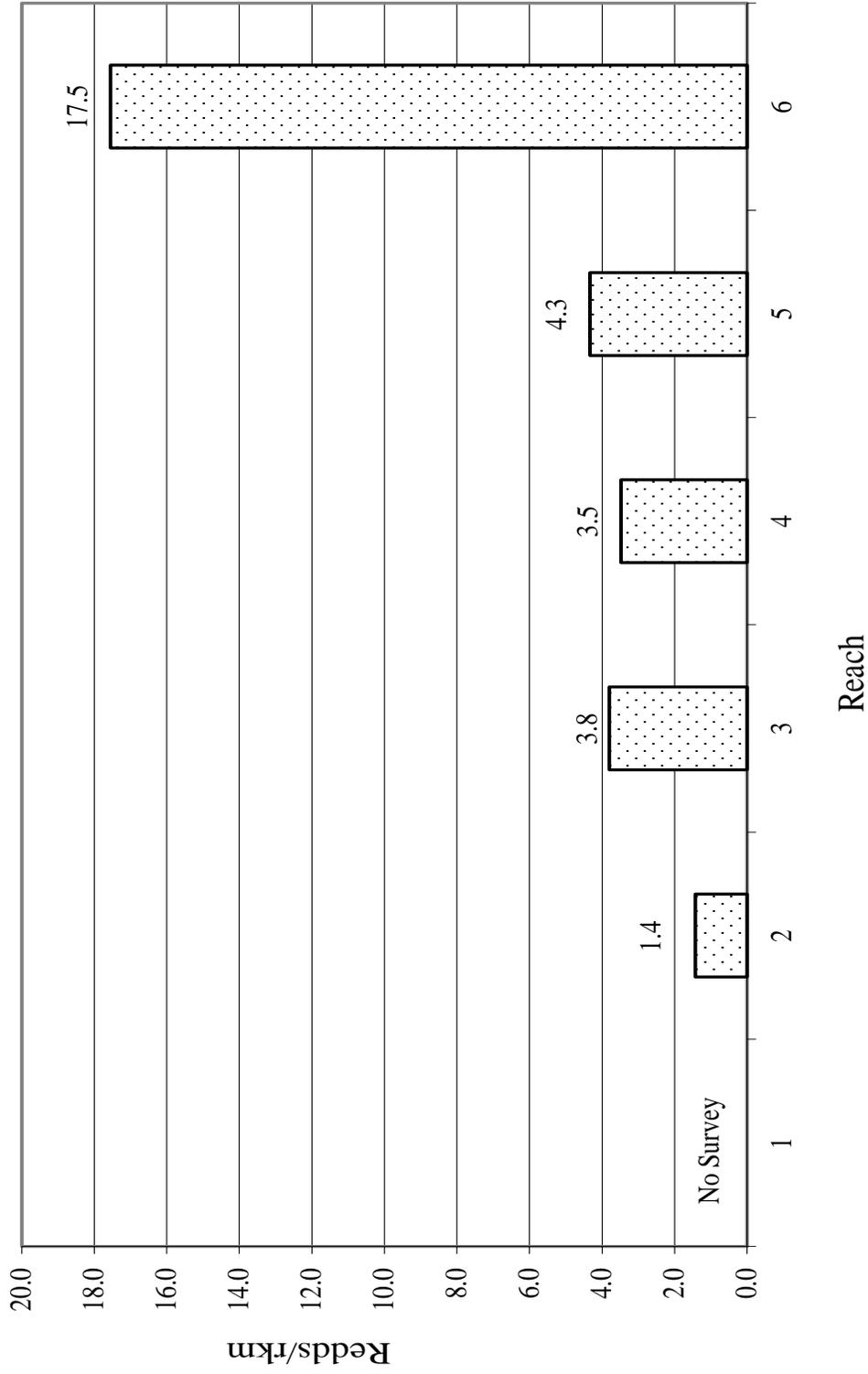


Figure 4. Mainstem Klamath River fall Chinook salmon redd density (redds/rkm) by reach, 2011.

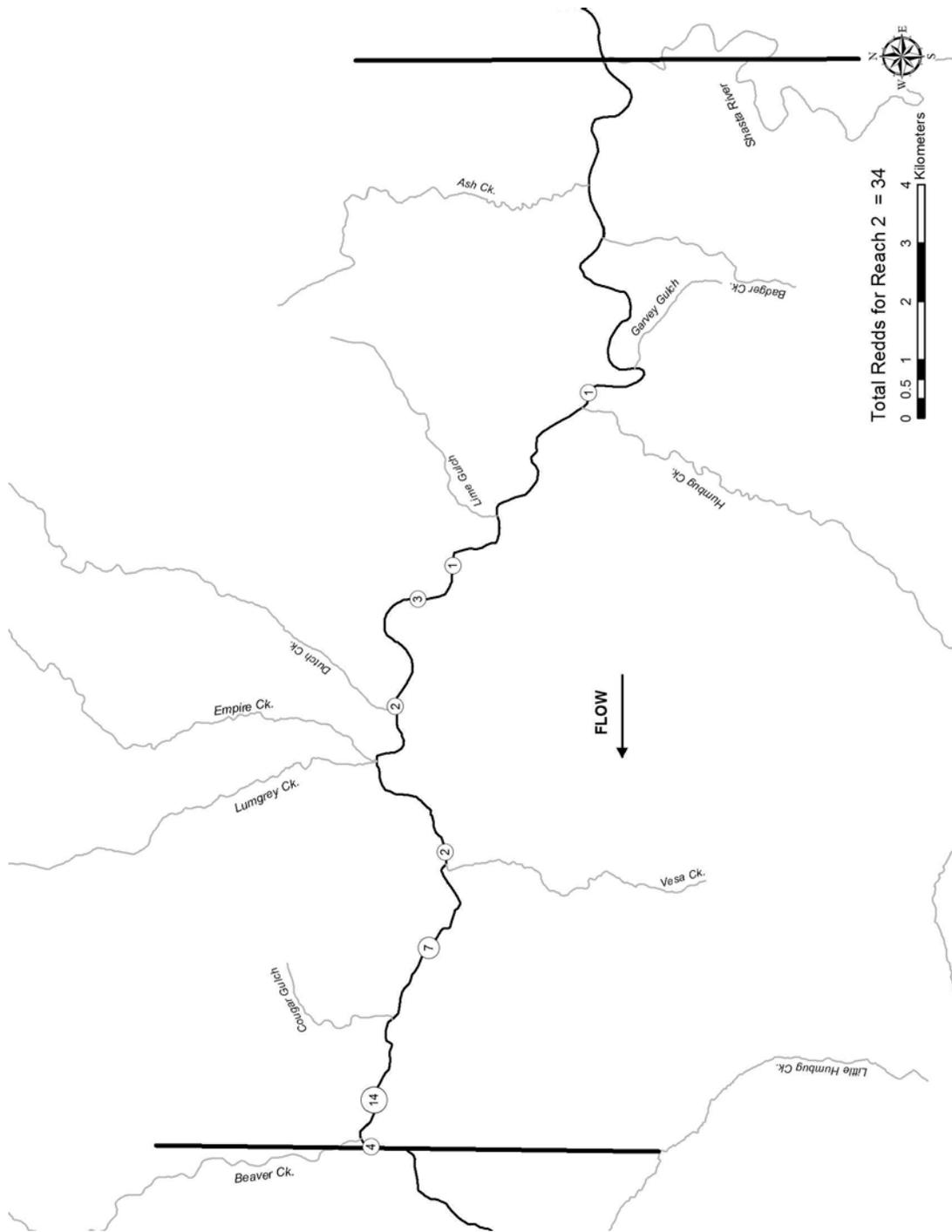


Figure 5. Redd distribution in Reach 2, (Shasta River to Beaver Creek), mainstem Klamath River, 2011.

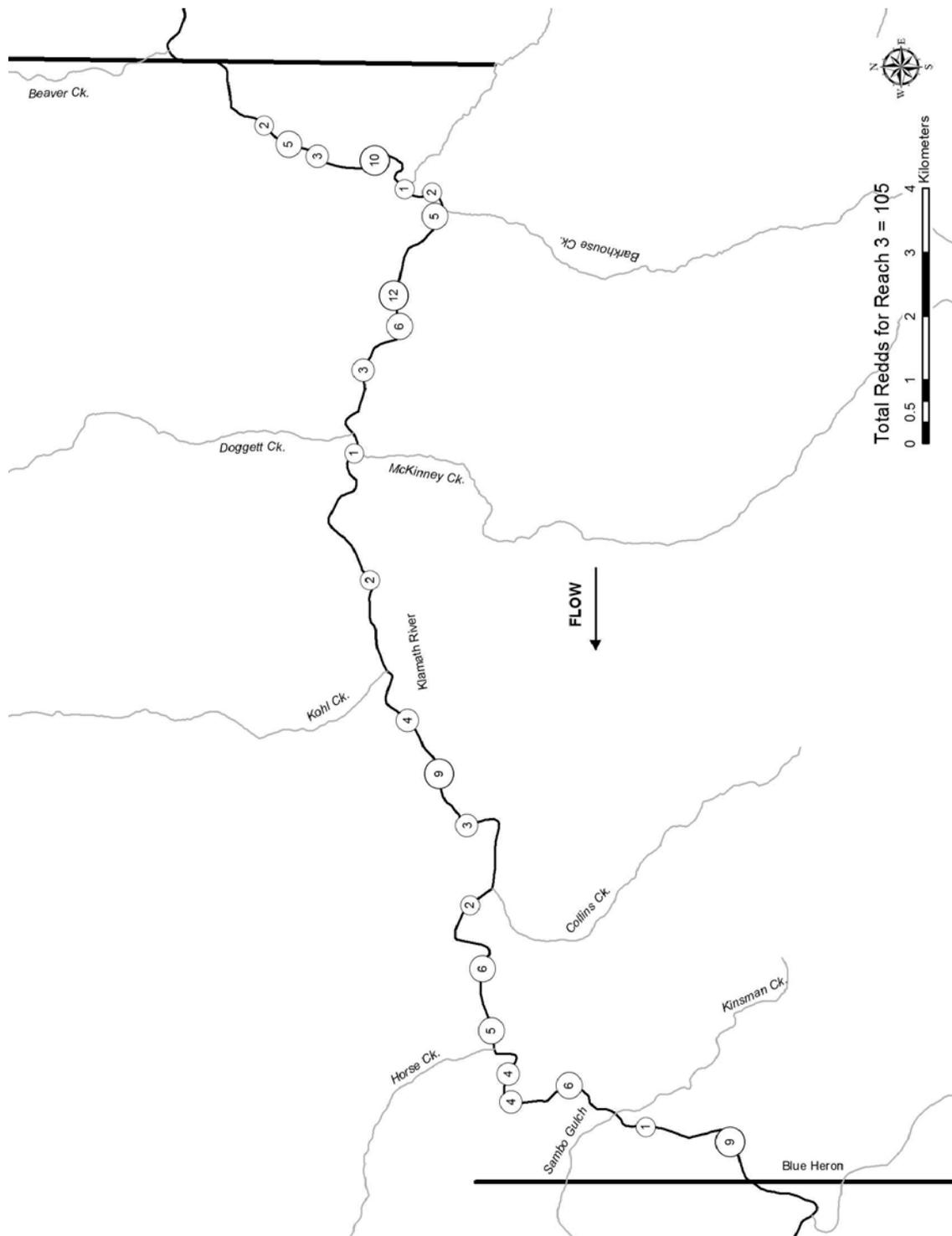


Figure 6. Redd distribution map for Reach 3 (Beaver Creek to Blue Heron river access), mainstem Klamath River, 2011.

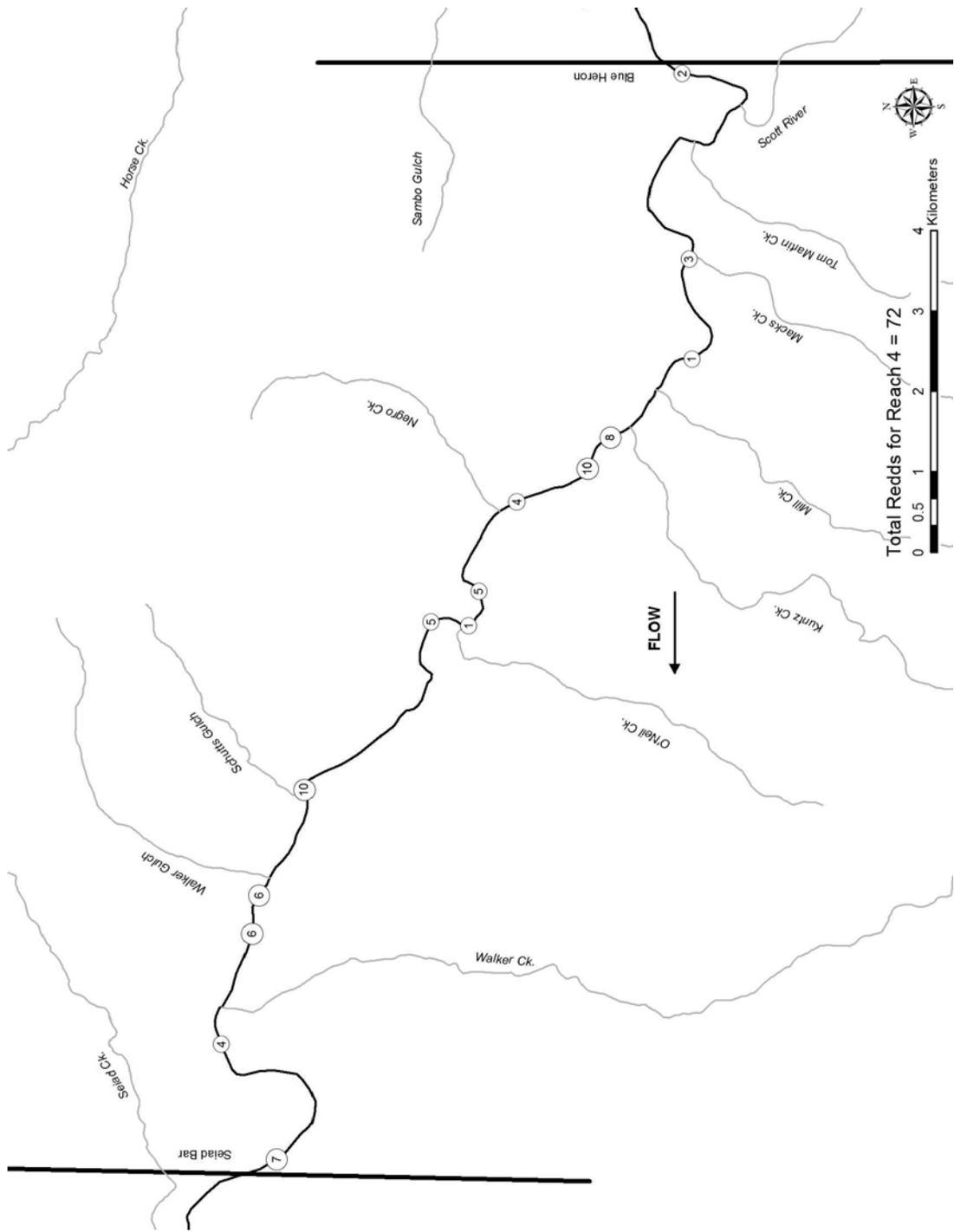


Figure 7. Redd distribution map for Reach 4 (Blue Heron to Seiad Bar), mainstem Klamath River, 2011.

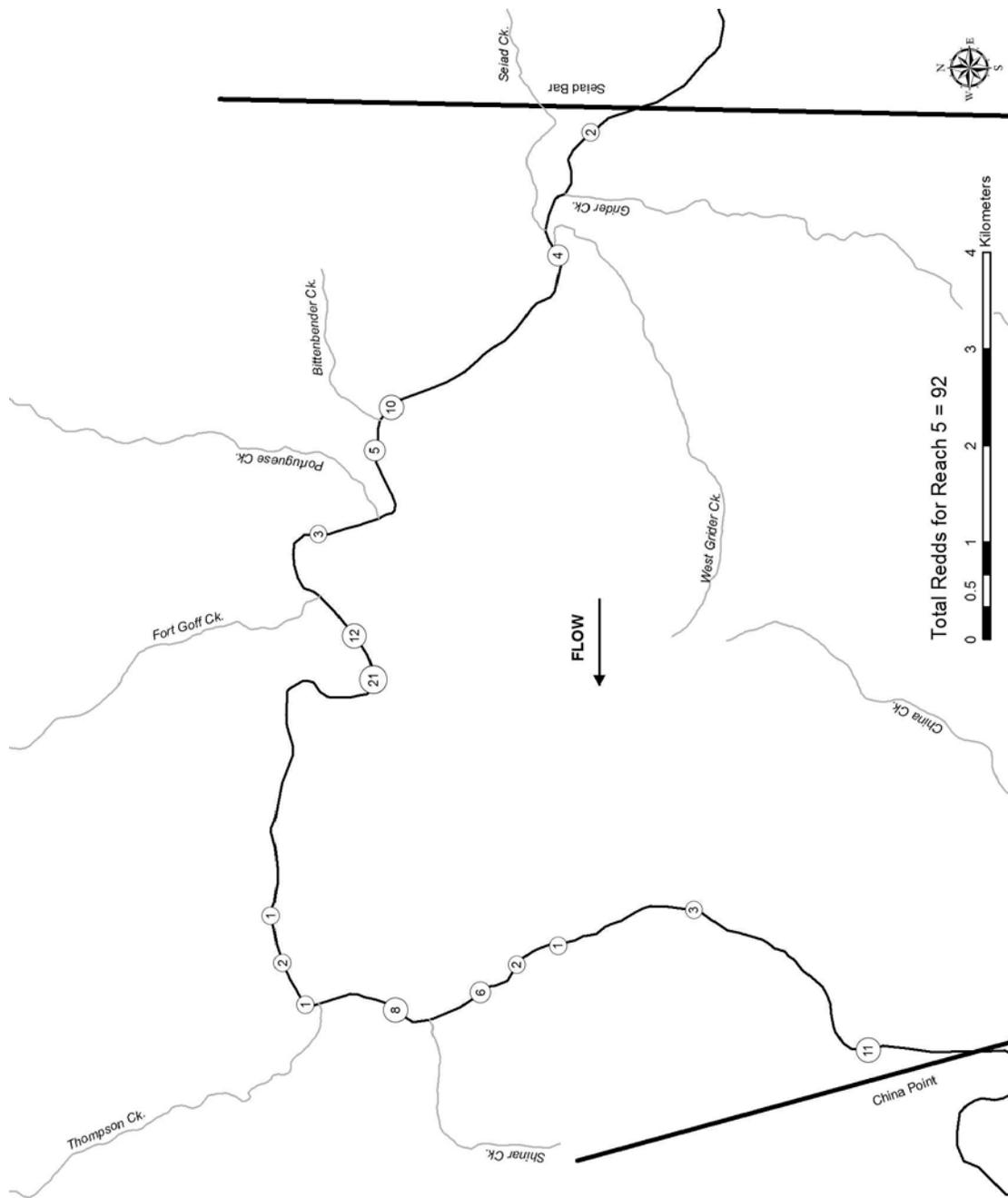


Figure 8. Redd distribution map for Reach 5 (Seiad Bar to China Point,) mainstem Klamath River, 2011.

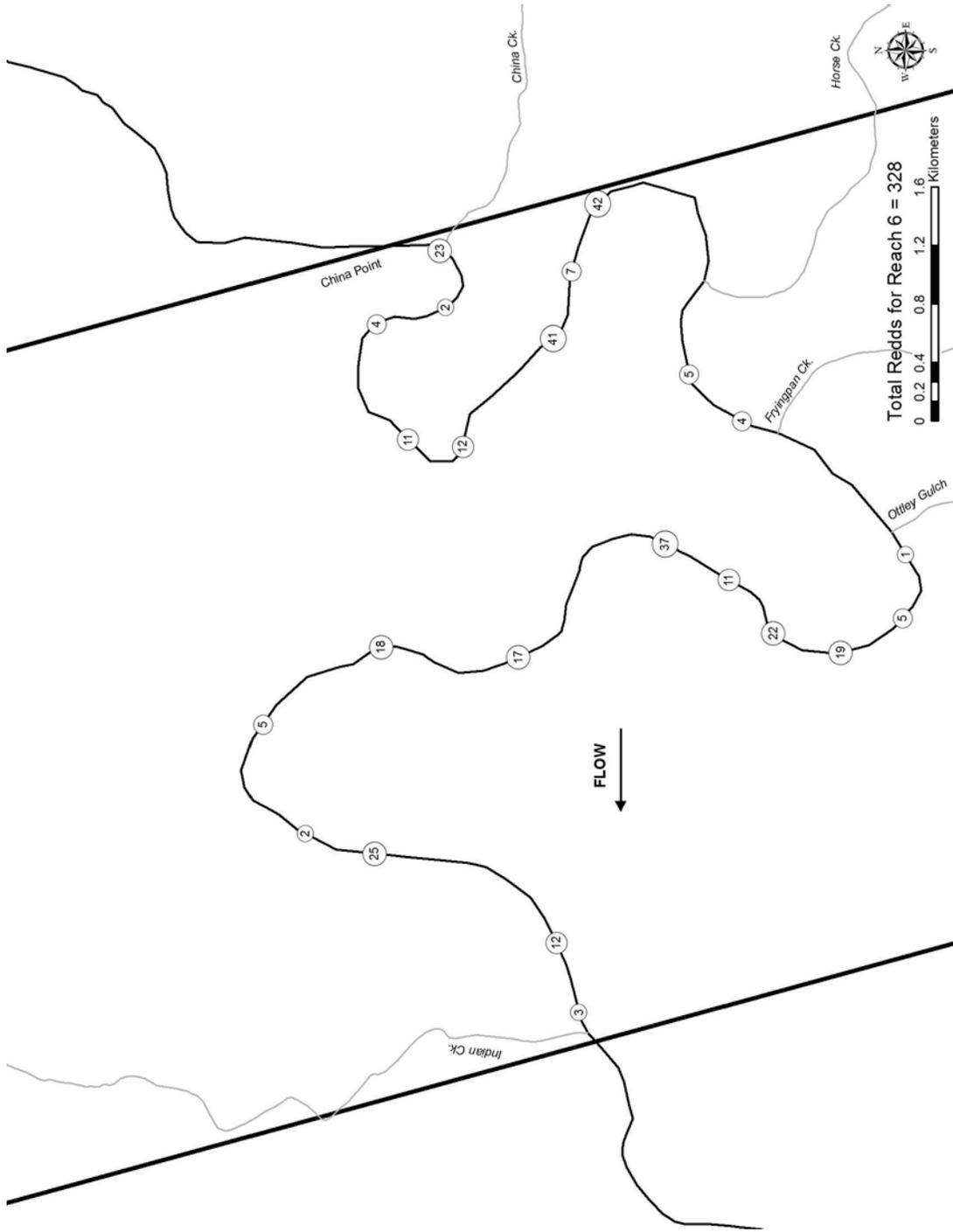


Figure 9. Redd distribution map for Reach 6 (China Point to Indian Creek), mainstem Klamath River, 2011.

Table 4. Fall Chinook salmon redd density by 10-rkm (approximate) sections on the mainstem Klamath River, 1993 to 2011 ("Ns" = No survey).

| Tributary<br>Reach                                   | Reach<br>Length<br>(rkm) | Year |      |       |      |      |      |      |      |      |       |       |      |      |      |      |      |      |      |      |
|--|--------------------------|------|------|-------|------|------|------|------|------|------|-------|-------|------|------|------|------|------|------|------|------|
|  |                          | 1993 | 1994 | 1995  | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002  | 2003  | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| Iron Gate Dam (309.8) to<br>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 | Ns   | Ns   | Ns   | Ns   | Ns   |
| Cape Horn Creek (300.6) to<br>Shasta River (288.5)   | 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  | Ns   | Ns   | Ns   | Ns   | Ns   |
| Shasta River (288.4) to<br>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  | 1.1  | 2.4  | 4.3  | 0.6  | 0.1  |
| Humbug Creek (279.7) to<br>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  | 3.5  | 5.0  | 4.8  | 1.4  | 0.7  |
| Vesa Creek (268.3) to<br>Little Humbug Creek (257.5) | 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  | 5.5  | 8.1  | 13.5 | 7.3  | 4.2  |
| Little Humbug Creek (257.4)<br>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  | 5.9  | 5.9  | 19.2 | 3.1  | 3.2  |
| Kohl Creek to (248.0)<br>Kinsman Creek (237.1)       | 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  | 4.5  | 4.3  | 9.7  | 1.0  | 3.9  |
| Kinsman Creek (237.0) to<br>Kuntiz 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  | 4.2  | 6.0  | 11.9 | 2.0  | 1.7  |
| Kuntiz Creek (227.3) to<br>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 | 9.9  | 9.7  | 16.1 | 10.1 | 5.2  |
| Walker Creek (217.0) to<br>Portuguese Creek (207.7)  | 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  | 3.6  | 4.4  | 16.3 | 5.6  | 3.4  |
| Portuguese Creek to (207.6)<br>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  | 2.8  | 4.3  | 9.1  | 1.9  | 5.6  |
| Shinar Creek (199.1) to<br>China Creek (192.0)       | 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  | 4.2  | 7.6  | 15.4 | 6.1  | 6.7  |
| China Creek (191.9) to<br>Ortlely 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 | 19.0 | 17.5 | 41.3 | 12.2 | 15.4 |
| Ortlely Gulch (183.7) to<br>Indian Creek (173.9)     | 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 | 10.9 | 19.4 | 34.6 | 16.9 | 17.9 |

Creek (rkm 268.3; 0.7 redds/rkm) sections. Whereas three sections, Portuguese Creek (rkm 207.6) to Shinar Creek (rkm 199.1), Shinar Creek to China Creek (rkm 192), and Ottley Gulch to Indian Creek, had higher redd densities (Table 4) than the previous 18-year average ( $\bar{x}$  = 5.3, 6.5, and 12.1 redds/rkm, respectively).

### **Water Quality**

Mainstem Klamath River mean daily water temperature decreased from 16.2 to 7.8°C over the survey period (October 12 to December 1, 2011; Figure 10) at the Iron Gate Hatchery Bridge and from 15.0 to 6.5°C near Seiad Valley (Figure 11). Secchi disk depth readings ranged from 2.4 to 4.0 m ( $\bar{x}$  = 2.9 m) during these surveys. The lowest Secchi disk depths were recorded on October 14, November 1, and November 3, while the highest was measured on November 30. Water visibility was generally lower during periods of higher discharge, cloud cover, and precipitation.

### **Discharge**

Discharge during the 2011 survey period in the mainstem Klamath River ranged from 1,012 to 1,671 ft<sup>3</sup>/s below IGD (Figure 10) and from 1,442 to 2,147 ft<sup>3</sup>/s near Seiad Valley (Figure 11). The mean daily discharge was 1,241 ft<sup>3</sup>/s below IGD and 1,718 ft<sup>3</sup>/s near Seiad Valley.

### **Suction Dredge Mining**

A statewide ban on recreational suction dredge mining was imposed August 6, 2009. Recreational suction dredge mining was not observed; however two new redds were observed on what appeared to be older suction dredge tailings at rkm 209.0 (Reach 5) and rkm 183.8 (Reach 6). These tailings were presumably created before the ban. Redds constructed on dredge tailings are generally more unstable in high flows than those constructed on naturally deposited substrate (Harvey and Lisle 1999).

### **Acknowledgements**

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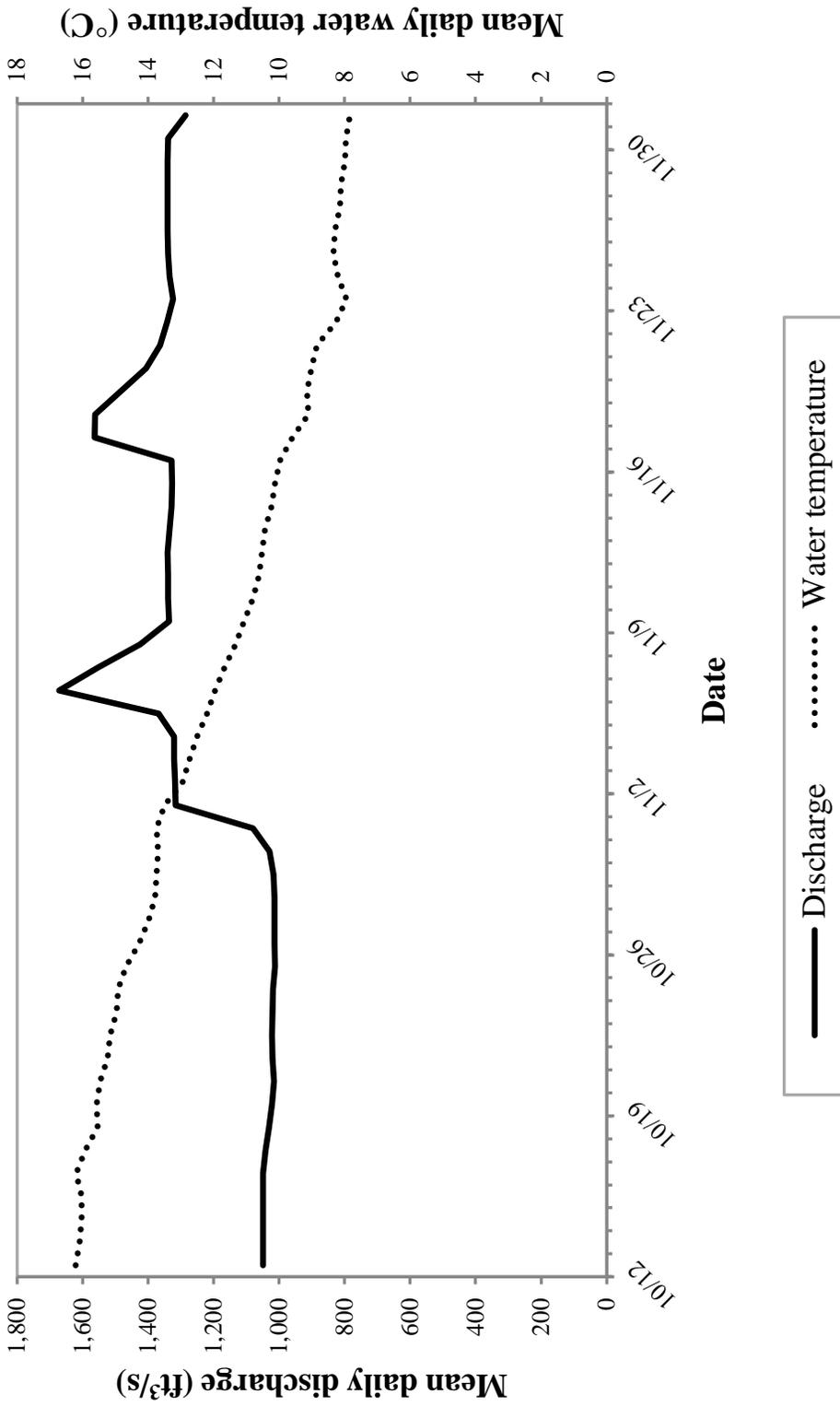


Figure 10. Water temperatures (°C) at rkm 309.9 and discharge (ft³/s) below Iron Gate Dam (USGS Gage 11516530) October 12 to December 1, 2011.

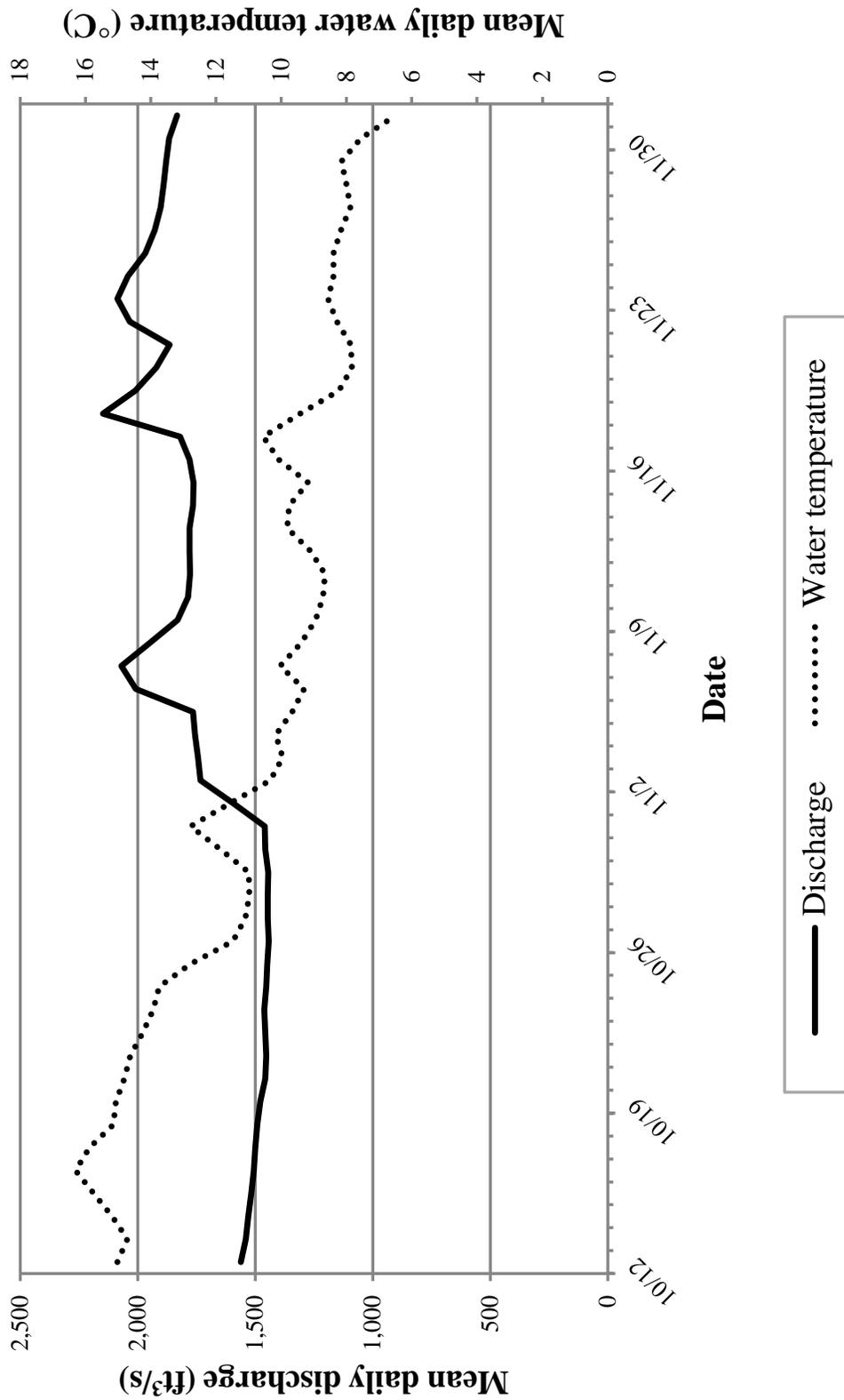


Figure 11. Water temperatures (°C) at rkm 206.8 and discharge (ft³/s) near Seiad Valley (USGS Gage 11520500) October 12 to December 1, 2011.

### Literature Cited

- Ayres Associates. 1999. Geomorphic and sediment evaluation of the Klamath River, California, below Iron Gate Dam. Prepared for U.S. Fish and Wildlife Service, Yreka, California, by Ayres Associates, Fort Collins, Colorado.
- CDFG (California Department of Fish and Game). 2012. Klamath River basin fall Chinook salmon spawner escapement, in-river harvest and run-size estimates, 1978-2011. Available from W. Sinnen, CDFG, 5341 Ericson Way, Arcata, California 95521.
- Flint, L.E., and A.L. Flint. 2008. A basin-scale approach to estimating stream temperatures of tributaries to the Lower Klamath River, California. *Journal of Environmental Quality* 37:57-68.
- Gough, S.A., and S.C. Williamson. 2012. Fall Chinook salmon run characteristics and escapement for the main-stem Klamath River, 2001–2010. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Technical Report Number TR 2012-14, Arcata, California.
- 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.
- KRTT (Klamath River Technical Team). 2012. Klamath River fall Chinook salmon age-specific escapement, river harvest, and run size estimates, 2011 run. Available from the Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.
- 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, California.
- PFMC (Pacific Fishery Management Council). 1988. Review of 1988 ocean salmon fisheries. Portland, Oregon.
- USFWS (United States Fish and Wildlife Service). 1991. Annual report: Klamath River fisheries assessment program, 1989. Coastal California Fishery Resource Office, Arcata, California.